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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

Institution of British Foundrymen.

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The Ruhr and the Foundries.

At the outset, we would state that these notes are non-political, and are designed to show the effect of dislocation in the Ruhr area on the British foundry industry. Primarily, it should be understood that the Ruhr district contains the fuel-providing area for not only the metallurgical industries on the German side of the Rhine, but is also the natural source of fuel for a huge network of industries in Eastern France, especially Lorraine, which contains vast deposits of iron ores. To give a British equivalent, but on a smaller scale, the cutting off from Middlesbrough of Durham or Northumberland coal would dislocate, at least temporarily, the Cleveland furnaces. Cleveland would look for fresh sources of coal. Germany, too, disliking to buy French ore, looked for other supplies, and placed orders in Newfoundland. At the moment, both France and Germany and other countries dependent on either the one or the other are being forced to look further afield for their raw material. In the opinion of a writer in the "Iron Age," it is Great Britain which will get the lion's share of this business. This "business," at least at the moment, is the obtaining of coke and pig-iron, the two chief raw materials of the cast-iron founding industry. If conditions were normal in Great Britain, business could be reasonably expected to expand to meet the situation. But conditions are not normal. Less than one-third of the blast furnaces are in operation. The question obviously arises, "Then why not blow in more?" Unfortunately, this obvious solution is difficult of realisation, for not only is coke distinctly dear, but it is also extremely scarce.

From the above, it is fairly obvious that British foundries are not merely to suffer from higher prices, but will possibly have to face a famine in prompt iron. It is also apparent that coke, too, may even advance above the present famine prices. Whilst it is no consolation to know that the Continental works will be still worse placed, it may create circumstances which will allow foundries to compete in markets hitherto found to be difficult. Great Britain was the first to settle down after the Napoleonic wars, and to this is often ascribed much of our success in export business. If history repeats itself, Britain may have a chance of regaining some of its pre-war prosperity. As a key industry, the foundries of Great Britain are bound to feel immediately any increased business in no matter what direction. Agriculture, textiles, chemicals, shipbuilding, engineering, metallurgical, are all contributors to the prosperity of the foundry. It behoves all foundrymen to study carefully the present political situation, as at the moment it has a very definite bearing on the raw material markets in which they are, or should be, vitally interested. They should visualise, as far as possible, the effect of a permanent high tariff wall between Ruhr coal and Lorraine ore; the possibility of a commercial *entente* between German coalowners and French ironmasters. They should ascertain the ultimate market reached by this area as a whole, as there may exist, at least temporarily, markets which can be filled by British goods. It is almost a business maxim that it is easier to maintain markets than create new ones. Now is the moment for trying to get into the new ones. The industries at present handicapped by the disturbance are of world-wide importance. They are equipped with all that is latest and best—especially those in the devastated areas of France—and to compete with these works British foundries, too, must see to it that they are also equipped with every labour-helping device. It is an ill-wind which blows nobody any good, and this "incident" may, if handled judiciously by British industrialists, bring "grist to the British mill," to mix our metaphors.

Machine Moulding Methods.

London foundrymen are invited to a meeting of the Institution of Production Engineers, to be held at the Engineers' Club, Coventry Street, London, W.1, on February 23, at 7.30, when Mr. T. F. Hardyman, manager of the Westland Foundry, Yeovil, will read a Paper on the above subject.

The Embrittling Action of Sodium Salt Solution on Mild Steel.*

By T. SWINDEN, D.Met.

The type of failure under discussion is quite distinct from ordinary rupture arising from stressing beyond the normal static strength of the fatigue type of fracture due to repeated or alternating stresses causing slip within the crystals.

The embrittling action of certain salt solutions on mild steel is similar to the action of mercury and ammonium salts on stressed brass, causing what is now generally known under the term "season cracking."

The particular problem under discussion was the failure of mild steel plates forming the base of large evaporating pans operating upon mixtures of sodium and potassium nitrates. Whereas these pans lasted for many years without any abnormal failure, when evaporating brine, trouble was immediately experienced when the nitrate solution was substituted for brine, and the failures were a matter of vital importance during the war period.

Experiments showed that a steel plate laid loosely on the bottom of the pan was not deteriorated, whilst similar plates rivetted in the pan in the ordinary way, cracked. It is obvious, therefore, that stress is a necessary factor.

However, since the action of nitrates was so distinctly different from that of chlorides, it is suggested that selective chemical action is the fundamental factor in producing "season cracking" in mild steel. The analogous case of the action of sodium nitrate is already well known.

The author suggested that the embrittling action is due to an absorption in a state of solid solution of nitrogen or oxides of nitrogen from the nitrate solution by the material forming the intercrystalline boundaries.

Suggestions for overcoming this difficulty where steel is employed concluded the Paper.

Pig-Iron and Metallurgical Service.

Owing to the demand by foundries for pig-irons of regular and definite composition, a new company has been formed with the object of filling this want. This new company is called British Pig Irons, Limited, and their offices is situated at 2, 4, 6 and 8, Victoria Street, Westminster, the directors being Mr. G. B. Taverner and Mr. T. M. Willis, both of whom are well known in the foundry industries.

It is their intention to make a speciality of giving metallurgical service. To do this they have been appointed concessionnaires and sole exporters to the Midland Coal, Coke and Iron Company, Limited, of Newcastle, Staffordshire. This firm have a battery of cold- and warm-blast furnaces. They claim that they do not ship direct from the pig beds, but analyse, grade, select and stack according to the analysis shown. It is interesting to note that low-carbon irons are stated to be invariably produced from suitable ores, and not by dilution with steel scrap. Another point which is emphasised is the length of time taken for the reduction of the ores by the cold-blast process. A feature is made of the willingness of the furnaces to provide pig-iron to the foundryman's analysis. If this practice can be successfully accomplished, it will constitute a useful advance in foundry practice.

Institution of British Foundrymen.

London Branch Programme Changes.

Owing to an insistent demand from the country members, the London Branch Council have asked Messrs. Benbow and Smith to postpone their lecture on Grey Cast Iron and Grey-Iron Castings from Thursday, March 1, to Saturday, March 3, at 4 p.m. M. Ronceray is to lecture towards the end of the following week. Details will be published later.

* Paper read before the Birmingham Metallurgical Society, February 8, 1923.

The Institute of Metals.

The annual general meeting of the Institute of Metals will be held, by kind permission, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1, on Wednesday and Thursday, March 7 and 8. The meeting will commence at 10 a.m. each day, concluding not later than 5 p.m. On March 7 the annual dinner of the Institute will be held at the Trocadero Restaurant, Piccadilly Circus, W.1, at 7.30 p.m.

The following communications are expected to be submitted:—

1.—"The Mechanical Properties of the Magnesium Alloys," by Dr. Leslie Aitchison.

2.—"The Ternary System Copper-Aluminium-Nickel," by C. R. Austin and A. J. Murphy.

3.—"Further Studies in Season-Cracking and its Prevention. The Removal of Internal Stress in 60:40 Brass," by S. Beckinsale.

4.—"The Inner Structure of the Crystal Grain as Revealed by Meteorites and Widmanstätten Figures," by Colonel N. T. Belaiew.

5.—"The Constitution of Some Alloys of Aluminium with Copper and Nickel," by Kathleen E. Bingham and Dr. J. L. Haughton.

6.—"Tests on Work-Hardened Aluminium Sheet," by Professor H. C. H. Carpenter and C. Coldron Smith.

7.—"The Recrystallisation of Cold Worked Cadmium," by Maurice Cook.

8.—"The Constitution and Age-Hardening of the Ternary Alloys of Aluminium with Magnesium and Copper," by Marie L. V. Gayler.

9.—"The Extrusion Defect in Brass Rods Extruded from a Multiple Die," by R. Genders.

10.—"The Scleroscope Hardness Test. A New Form of Magnifier Hammer," by R. Genders.

11.—"Volume Changes Accompanying Solution, Chemical Combination and Crystallisation in Amalgams," by Dr. Arthur W. Gray.

12.—"The Heat-Treatment and Mechanical Properties of Alloys of Aluminium with Small Percentages of Copper," by Dr. D. Hanson and Marie L. V. Gayler.

13.—"The Density and the Hardness of the Cast Alloys of Copper with Tin," by Harold Heape.

14.—"The Modulus of Direct Elasticity of Cold-Drawn Metals as a Function of Annealing Temperature," by Professor F. C. Lea, Dr. V. A. Collins and Dr. E. A. F. Reeve.

15.—"The Hardness of Annealed Copper," by A. L. Norbury.

16.—"The Hardness of Certain Copper Alpha-Solid Solutions," by A. L. Norbury.

17.—"The Oxidation of Metals at High Temperatures," by N. B. Pilling and R. E. Bedworth.

18.—"The Structure of Eutectics," by A. M. Portevin.

19.—"Some Properties of the Copper-Rich Copper-Aluminium Alloys," by R. C. Reader.

20.—"The Production and Heat-Treatment of Chill Castings in an Aluminium Alloy ('Y')," by Dr. W. Rosenhain, S. L. Archbutt and S. A. E. Wells.

May Lecture.

This will take place on May 2 at the Institution of Mechanical Engineers, at 8 p.m., when Dr. W. Rosenhain, F.R.S., will deliver an address on "The Inner Structure of Alloys."

Annual Autumn Meeting.

The annual autumn meeting will be held at Manchester in September.

CORRECTION.—Mons. Ronceray informs us that Mde. Ronceray has not been appointed chairman of the A.T.F. Ladies Committee. We regret that what one would have expected to be a reliable source failed us, and we extend to Mons. and Mde. Ronceray our sincere apologies.

THE L.E.W. COMPANY, LIMITED, of Park, Tottenham, London, N.17, announce that they have acquired the entire undertaking and goodwill of the London Emery Works Company, Limited. Apart from manufacturing emery cloth, wheels and machinery, they also have a department for moulding machines and foundry specialities.

Aluminium Foundry Practice.*

By E. H. Tyson.

Discovery of the Metal.

Aluminium was found in 1827 by Wohler, who succeeded in isolating an extremely small quantity in the form of a powder. In 1845 Wohler again succeeded in isolating a few small metallic globules, although these were not pure. But in 1854 Deville succeeded in isolating the metal in a state of almost perfect purity, and immediately set to work to discover a process of producing aluminium. This is produced from alumina, contained in the mineral bauxite. Years before this, however, the metal was suspected, and many chemists tried to isolate the metal, but without success.

Since 1889 the production of aluminium has increased largely; in that year the total output was only 85 tons; in 1905 it was 8,000 tons.

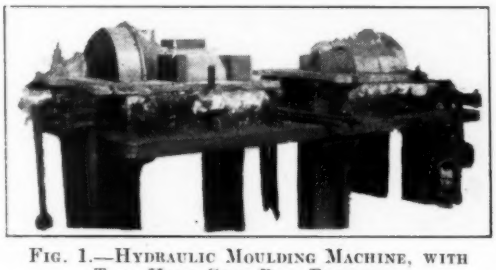


FIG. 1.—HYDRAULIC MOULDING MACHINE, WITH TWO HALF GEAR-BOX PATTERNS.

Use of Aluminium.

To-day it has a widespread use in engineering, automobile and aircraft work, and is rapidly replacing the more common metals. It is also largely used for the manufacture of domestic articles.

For cooking utensils, it is used in the pure state. It is possibly the best metal obtainable for this purpose, because of its cleanliness and lasting qualities. The author has made castings ranging from a small pudding basin up to 200-gallon pans, which are used for cooked meats. These are also used for sugar boiling, which in both cases are much cleaner than copper pans, which are subject to verdigris, or enamelled pans which often chip.

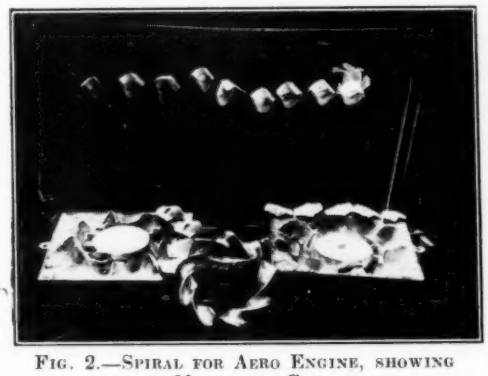


FIG. 2.—SPIRAL FOR AERO ENGINE, SHOWING BOTH MOULD AND CASTING.

Aluminium alloy castings containing 12 per cent. Zn, 3 per cent. Cu, and the remainder aluminium, is the best mixture for crankcases, gearboxes, or other castings requiring a good tensile and elongation. It is very easy to raise the tensile by adding more Zn, but only at the expense of the elongation.

Zn to the extent of 20 to 25 per cent. is easily alloyed, but could only be used for very common castings on account of it being liable to cracks and breakages under vibration.

In aluminium alloys a good purity aluminium is required, say from 98.5 to 99.5 per cent. The iron impurity should not be more than 0.5 per cent. It is also of great importance that the Zn and Cu should be of high purity, and that the Cu should be free from arsenic. This alloy is also improved by introducing manganese from 0.1 to 0.15 per cent., as it renders the alloy tougher and more easily machined. This is introduced as manganese copper.

Magnesium introduced to this alloy up to 0.5 per cent. increases the tensile and helps to eliminate cracking, but spoils the look, the castings having a dull grey appearance. It is also a rather

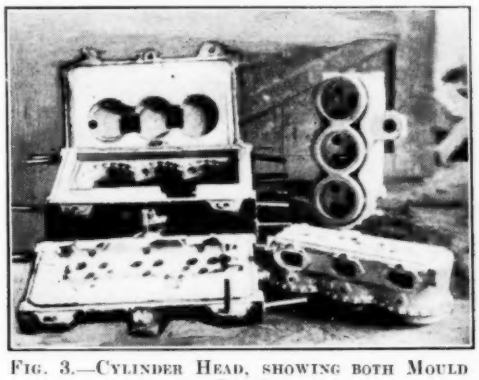


FIG. 3.—CYLINDER HEAD, SHOWING BOTH MOULD AND CASTING.

expensive metal to use, the cost being 4s. 9d. per lb. The 50:50 aluminium alloy is first melted in a plumbago crucible run into ingots, and then adjusted to contain the required percentage of Cu. The aluminium is melted, the 50:50 alloy is put in, and the Zn introduced just before the metal is ready for casting. Pouring temperature should not be more than 750 deg. Cent. for any casting; this, however, would be too high for crankcases or gearboxes. For this class of casting 670 to 700 deg. Cent. is recommended.

The temperature of the metal should be taken with a pyrometer. It cannot be judged by the eye, and if the pouring temperature in the ladle is too high it should be allowed to cool until the proper temperature is recorded. The metal should not be cooled by dropping small scrap in, such as runners and risers.

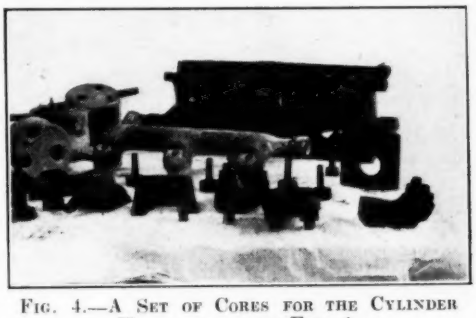


FIG. 4.—A SET OF CORES FOR THE CYLINDER HEAD, SHOWN IN FIG. 3.

Furnaces.

There are several types of furnaces for the melting of aluminium. An oil furnace, however, is much cheaper and faster melting than coke or gas. With coke there is associated the cost of cartage and clearing away rubbish. It is much better than the open-flame barrel type, where the flame comes in contact with the metal, as the melting losses are much greater than this type, because of oxidation.

Most of the American foundries use single pot furnaces, which apparently introduce a great loss of heat. The author has seen as many as 20 single-pot furnaces in a row, each provided with a separate burner.

* A Paper presented to the Birmingham Branch of the Institution of British Foundrymen. Mr. W. F. Flavell in the chair.

One American writer says, with furnaces of three pots and upwards, there must be a burner each end, and blowing alternately if success is desired. This is not in accordance with the author's experience, although it may be that with a burner at each end it would result in a quicker melt. This would necessitate the cutting out of another device which is installed on this furnace;

FIG. 5.—CRANK CASE PATTERN ON BOARD, TOGETHER WITH THE MOULD.

that is, a chamber for keeping plumbago crucibles hot, ready for casting, which uses up the otherwise waste heat. The furnace provides for five pots, each holding 500 lbs. of metal. A varying rate of melting is shown by each.

During the latter part of the war only a mixture of 50 per cent. crude oil and 50 per cent. pitch was available, which gave satisfaction. Obviously the oil had to be maintained at a very good temperature, or there would soon have been a stoppage in the pipes.

The blast is provided by a blower through a 3-in. pipe at a pressure of 2 lbs. per sq. in. The oil is fed by gravity from an overhead tank.

Whatever type of furnace is used, it is advisable to melt as fast as possible, as it is preferable to keep the moulders waiting for metal than to keep the alloy stewing in the pots. This or overheated metal is usually the cause of drawing and cracking.

Moulding Machines.

There are a good many types of moulding machines. Although the author prefers the jolt-ram for most classes of work, it is desirable to have several types of machines, as no one make suits all the different types of castings made in a foundry.

One small jolt core machine has been used for making moulds for an air-cooled aluminium cylinder. This being a pattern where only a few off are wanted, and which was impossible to ram by hand and get a good lift, the fins being too

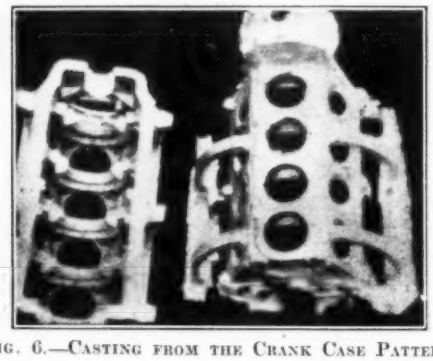


FIG. 6.—CASTING FROM THE CRANK CASE PATTERN.

deep. The one half-pattern was placed on the machine with a wood frame around it, leaving just sufficient space for sand to jolt it up. The frame was taken off, and a box part was placed on the machine, filled with sand and hand rammed, but not heavily. This was then turned over, showing the joint. The other half-pattern was put on the machine and rammed the same way in the wood frame. This was then placed on the first half-mould and the frame removed. A box part was placed on and rammed as before, the moulding box was parted, and the pattern drawn. The reason for this was to use the dowels to ensure the two halves of the pattern coming together.

A loose part, which was rather troublesome through the sand being jolted away, was overcome by ramming up an oil-sand core in the mould, covering the loose piece.

The hydraulic hand-rammed machine, with stripping plates, shown in Fig. 1, takes two half-gear-box patterns mounted. The machine contains a good device for protecting the stripping plate.

American Visit.

In an American foundry visited by the author a six-cylinder crank case was being made on a roll-over jolt machine, and with it six men were making 150 bottom-half moulds per day, and twenty men making the top-half mould, coring up and knocking out castings from the boxes as they were cast. The castings were then put on to a travelling platform and carried to the cleaning room, where the sand is knocked out, which drops through a grating, and is carried away on a conveyor to the sand mixer. Here a continual spray of water is running that is just sufficient to damp the sand to keep it at the correct moisture content.

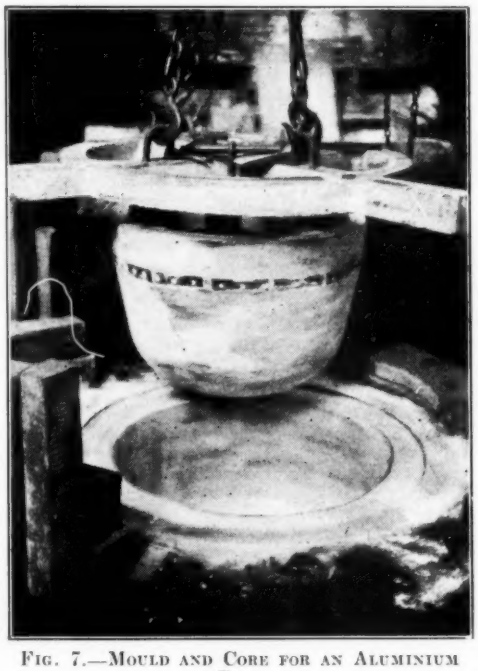


FIG. 7.—MOULD AND CORE FOR AN ALUMINIUM PAN.

From the mixer the sand is taken by an elevator to conveyors, which carry it to the different hoppers above the moulding machines. The slide is drawn, the moulding box is filled, and then jolted.

All the cores in this case were dry-sand, mostly oil-sand. In another foundry visited five men were making sixty oil-bases per day. The sand in this foundry was carried on conveyors, then put through an electric riddle over the moulding machines. All small work here is done with pattern plates, and hand-rammed with vibrators attached.

A very good system was in use for making small pipes on a double squeeze machine. The sand was put through the electric riddle, the squeeze put into action, the mould turned over, and the cores placed in the mould, the top half closed on, the mould pushed through the box, and placed on the floor ready for casting. This was one of the fastest jobs the author has ever seen.

The core shop in this foundry had a fine system. The sand mixer was on the ground floor, and from here the sand is carried by an elevator to the core shop overhead. Cores are made and put on to a roller conveyor, at the end of which they are run on to another conveyor, which passes through an

electric furnace, the cores gradually reaching the ground floor. This takes about 1½ hours, by which time they are dry, and are then placed on shelves for cooling. The core plates are put on to another elevator, which carries them back to the core shop.

In another modern core shop the cores were placed on a conveyor, where girls gauge and dress them whilst in motion, each girl having a specified part to do. Some of the cores were placed on a rotary table and passed under a grinding wheel to

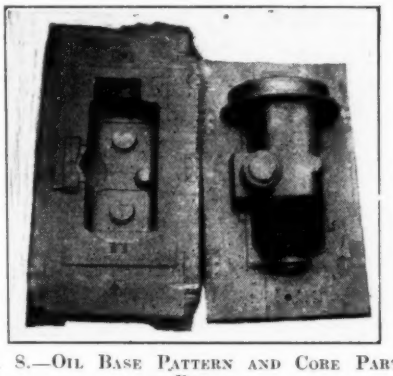


FIG. 8.—OIL BASE PATTERN AND CORE PART ON A BOARD.

give an exact depth. From here they passed on to the conveyor again for further examination. Then the cores are sprayed on a revolving table and removed to another conveyor, which passes them through an electric furnace for drying. The men in these foundries work very hard, much harder than in any foundry in this country.

Contraction.

There is apparently no definite contraction associated with aluminium, and even to-day pattern-makers are allowing as much as 1 in 60, others 1 in 80, or even 1 in 96. It is a point well worth investigation by the Institution of British Foundrymen, as suppliers of contraction rules declare that they would only be too glad for some official body to decide what the contraction should be, so that they could set up their machines to suit, as they have had so many different contractions suggested.

After having made many careful measurements, the author found that from a casting 9 ft. 6 in. long it is not often one gets a chance of checking. With a casting of this length made from 8 per cent. Cu and the remainder aluminium the con-

FIG. 9.—OIL BASE PATTERN CORE PART AND CASTING.

traction was found to be 1 in 84. Another casting made from 12 per cent. Zn and 3 per cent. Cu the contraction was 1 in 78. Therefore the nearest and best the author can suggest is 1 in 80.

Hand Moulding.

Quite often this is a complicated job for any moulder; for instance, the spiral for an aeroplane engine, shown in Fig. 2, which shows the casting, the mould, top and bottom halves. There are eighteen cores and nine drawbacks. It resembles a three-blade screw. The inside of the screw is cored by the cores shown, and the drawback takes the outside top and bottom. The casting is run from the inside by a spray.

Fig. 3 shows a cylinder head for an aeroplane engine. As will be seen, this is rather an intricate job. The casting is made of 7 per cent. Cu, the remainder being aluminium. In a recent article on aluminium moulding, a writer was speaking of this same alloy, and said the cores must be released as soon as possible after casting to avoid cracking. The author is not in agreement, as he often leaves such castings in the sand till cold, and has not had any trouble with cracks. If these were cast in a Zn-Cu aluminium alloy it would be necessary to release the cores soon after solidification. Fig. 4 shows the cores for this casting, which are made from oil-sand.

Fig. 5 shows a crank case pattern and bottom-half mould, which is poured with horn gates. This system shows advantages, as it allows the air to escape, and helps to eliminate air traps. There are no risers, only air vents through the top, but feeding heads are on the feet and flange. These are cut off by a horizontal band saw. The author does not favour risers, and dispenses with them wherever possible.

The majority of moulders like to employ as many as possible on the top of a casting. Apparently there is some fascination in pushing a tube through the sand.

Fig. 6 shows the casting from the pattern shown in Fig. 5.

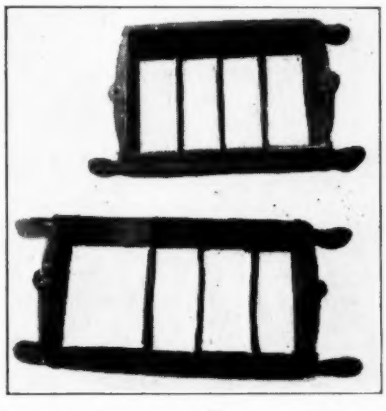


FIG. 10.—ALUMINIUM MOULDING BOXES.

Fig. 7 shows a mould and core for an aluminium pan which was mentioned earlier. It was made from a discarded pan, and was rammed up in the floor, the core part rammed up on a grid which is bolted to the cross shown. Stakes are driven into the floor as a guide for the cross, and cores placed round to form the flange. This is a quick way of making a pan of this description. Many are made the other way up, but then if it should be a 200-gallon pan it would take a very large top part. This system eliminates any box parts. If no electric crane exists, it would be difficult to lift. The method is to insert a prop from the top of the cross to the crane overhead in order to save the core lifting when casting. The casting is run from under the cores on to the flange.

Oil Bases.

Fig. 8 shows an oil-base pattern and core part, both being made on boards. With this system of moulding it is possible to use mostly unskilled labour, and is also a considerable saving in pattern repairs. The author's foundry has made 500 castings off this without any repairs whatever, and it is expected to get another 500 before it goes into the pattern shop. Of course, with this type of moulding all the box-parts must be interchangeable.

Fig. 9 shows a similar oil base and corepart to Fig. 8, but it also includes the finished casting. The body and flywheel end are made in green-sand and front end in dry-sand. No less than 3,000 castings have been made off this pattern.

Change-speed gear-box cover-patterns are made on boards, as also is the core part. The core for

the change-speed slots is placed in the pattern and rammed in the mould, which, being an oil-sand core, it ensures making good clean slots, and is much easier than trying to draw the slots or to make them in the internal core. This method enables a boy to make good castings, but if it were a loose pattern it would be a skilled job, and perhaps result in not so many castings. We have very few loose patterns that are possible to mould in this manner. The idea of this system originated when pattern makers were scarce, and would not work overtime for making duplicate patterns in order to keep up to the required demand for castings. There were occasions when we could not get repairs done, and this helped to solve the problem.

Moulding Boxes.

The type of moulding box used is shown in Fig. 10. They are made of aluminium, the sides and ends being cast separate, and afterwards bolted together. The bars are bolted in to suit the particular job in hand. These have been made in standard sizes of 6, 9 and 12 in., so that if a wider or narrower box is wanted we take these to pieces, and put in what ends are needed. The gun-metal bushes are run in with white metal from a master box.

Most aluminium foundries use wooden boxes, which are often very expensive, as they get burnt, and the pins become loose. There is often too much straining when lifting, associated with the cracking of the mould, causing an undue percentage of scrap. Wood boxes are much heavier than aluminium, and it might be thought expensive to carry 4 or 5 tons of such boxes in a foundry, but the expense is soon saved by the extra turnover shown.

Blow Holes, Porosity and Unsoundness.

Blow-holes are often caused by sand being too damp, moisture on chills, or cores being not properly vented. Many are of the opinion that cores and moulds for this metal do not require venting, but from experience it can be stated that one cannot vent too much.

Air traps are often called blow-holes. Absorption of gas by the alloys increases with increasing temperature, and the gases absorbed are often held in solution until solidification commences, when they are liberated, thus over-heated metal and pouring at too high a temperature causes unsoundness.

Porosity is often caused by insufficient venting. As an example, some castings containing a rather thin pocket of sand in the green-sand core all showed the same defect, resembling a deep segregation in the metal, or having the appearance of wood worm-eaten. The cause of this was ascribed to the mould not being properly vented, which caused the metal to come in contact with hard rammed sand, which produced a small puff of gas, just sufficient to disturb the metal before solidification. This was overcome by putting a vent in this particular part.

Porosity is often due to segregation in the metal. On the crown of an aluminium piston will often be found this trouble. When machined, very fine lines and pin holes appear, which can be overcome by chilling.

Many troubles are traceable to cores, and it is advisable to use green-sand wherever possible, because of the greatly decreased production costs, especially in large castings.

With some of the examples given green-sand cores made on boards are quite simple, but for crankcases and gearboxes greater care must be taken with the sand when used green than when making the cores of dry sand. Cracks are often traceable to cores, which are often too hard, or to the heavy parts not being properly chilled. If the gate is placed too near a heavy section this trouble is likely to appear.

Feeders.

If there is a heavy piece of metal on the joint face of a case it will be found that when the casting is taken out of the mould it will be sunk. If a riser is put on, no matter how large, one often finds a draw which one could get a pin down, because the riser is cooling quicker than the heavy metal underneath.

It appears simple to make a tube of, say, 4 to 5 in. dia. and 12 in. long of $\frac{3}{8}$-in. metal, and many would try to make this on end; but whether it is made on end or horizontally, there usually results a porous and very dirty casting. This trouble was overcome by casting it horizontally, and adding a strip which is easily cut off the casting.

A good method of running a large drum of 3 ft. dia. and 12 in. deep with $\frac{5}{8}$ in. metal is to use four wedge runners, and to allow the metal to fall to the bottom of the mould and gradually rise to the top with sufficient vents in the top part. It is advisable to run chills down the side of the runners, because of the heavy section in this part.

Coleman Core Stoves.

In our issue of January 25 we announced that Mr. C. Morehead, care of Messrs. E. T. White & Company, 1, Albemarle Street, London, W.1, who, by the way, is one of the founders of the Institution of British Foundrymen, had been appointed British representative to the Foundry Equipment Company of Cleveland, Ohio. This concern manufacture the Coleman core stove, and in the letter confirming Mr. Morehead's appointment they give us the following information, which is of interest for British foundrymen :—

"In years gone by cores were but an incidental part of the moulding process. To-day in some classes of foundry work, particularly in automobile and other production work, the mould is in reality a hole in the sand to be filled with baked cores. In some American foundries as much as a third of the floor space of the entire plant is occupied by the core department.

"It may be of interest to you to know that in the new plant of the Lycoming Motors Corporation, Williamsport, Pennsylvania, the main foundry proper is approximately 540 ft. long by 250 ft. wide. Of this area, the core department, exclusive of sand bins, occupies a space 400 ft. long by 90 ft. wide."

As previously stated, the catalogue issued by this firm is extremely interesting for all foundrymen.

Mesothorium.

Pure mesothorium has never been obtained, states the Bureau of Mines in Technical Paper 265, just issued. The product from monazite sand, even when fully as active weight for weight as radium, contains only about one-fourth of 1 per cent. of mesothorium by weight, practically the entire mass being barium and radium compounds. Likewise specimens of mesothorium free from radium prepared chemically from mantle ash, are barium compounds, the quantity of mesothorium constituting a mere trace. Notwithstanding the minute mass of mesothorium in such preparations, its relatively rapid rate of decay imparts to them a gamma-ray activity comparable to that of radium. The custom has thus grown up of expressing the quantity of mesothorium not, as with radium, in milligrams by weight, but by its gamma-ray activity.

Forges et Aciéries de Huta-Bankowa.—This Franco-Polish concern reports for the financial year ended June 30, 1922, profits totalling 2,341,000 fcs. (say £32,100), as compared with 67,773 fcs. in the previous year. There is to be no dividend. During the year under review some of the Company's works in Poland, which had been damaged during the war, have been restarted. Two out of the three furnaces are in blast, but the steel works are not yet working at full capacity. The plate and sheet mills and some of the other rolling mills are working steadily.

Electrification of European Railways.—The question of the electrification of the whole of the French railway net is being studied by a Parliamentary Commercial Committee. Stress is laid on the national character of the scheme, and also on the necessity of appealing for close collaboration between the electric-supply companies, the railways, and the Government. Such collaboration is to be put into practice by the formation of a sub-commission composed of members of Parliament, business men and qualified technical experts, who will prepare a report dealing with the practical side of the question for submission to the Committee. A message from Berne says that Switzerland is issuing a loan of 200 or 250 million francs (£10,000,000) to provide funds for the electrification of the Swiss railways.

XUM

The Evolution of the Foundryman.*

By W. H. Sherburn, M.I.Brit.F.

The Modern Awakening!

About the dawn of the 20th century the reflective foundryman realised that something was wrong in his craft. It did not command the recognition which its importance to general industry warranted. It seemed to have got into a *rather deep rut*, and he felt that if something drastic was not done quickly, it was in danger of sticking there. He looked around him and saw what associations had done for other skilled crafts, and was convinced that it could do as much for his own. He expressed his conviction in the Press, and it met with the desired response, and the British Foundrymen's Association was the outcome.

Having a shrewd idea of what was wrong, the pioneers set about putting it right. They soon realised that they had tackled a pretty big job. They found that many of those who ought to have been amongst the first to join them were the most difficult to get hold of. The foundry craft of that time was not without its full quota of men who could not see the value of association in the direction indicated. They were men who could not get away from the idea that they had inherited, or acquired, some valuable knowledge which it was to their interest to keep to themselves; *that they had no need of a technical Association;* and that the " other fellows " wanted to share their secrets, little dreaming—in their exclusiveness—that it was just possible they might get as much as they could possible give, perhaps more. This difficulty is slowly vanishing under the radiance of facts and wider knowledge, and the pioneers are seeing fruits of their *perseverance and vision.*

The necessities of the war period demolished many of the castles of the egotists, and taught us all, by rude lessons, how much there was for the best of us to learn, even of our own business. This brought about an extensive interchange of confidences—freely or under control—which, in two or three years' time, tended to project methods towards efficiency as far as a quarter of a century's previous normal record of exclusiveness had done. Whether we have taken full advantage of that experience *remains to be seen. It is to be hoped so.*

The Institution and its Influence.

The Association in course of evolution became the Institution, with full recognition and a Royal Charter and with a standing equal to other technical and scientific institutions of the highest type. The British foundryman of to-day, if he is taking advantage of his privileges, has no longer need to apologise for his existence. The importance and dignity of his craft is now generally acknowledged. Credit for this change is due to the many activities of the Institution and its members, and the invaluable co-operation of THE FOUNDRY TRADE JOURNAL.

Academic science and workshop practice, which a short time ago were scarcely on speaking terms, are now—through the Institution—grasping hands in hearty fashion, to mutual advantage. The chemist and physicist has found his natural place in the foundry, and the practical foundryman has discovered the usefulness of his colleague. They do not now say foolish things of, or to, each other, because—through the Institution—they are both wiser.

The Institution has always interpreted the term " foundryman " in its widest sense. It includes the managing director and the aspiring young foundry worker, and every grade between them. It also aims to engage every faculty of the man, mental and social, as well as physical. The co-operation of the *whole* man is necessary if we are to realise the highest ideal of a craftsman, who is master of his craft, and who, like Stradivarius, the violin maker, and Cellini, the metal worker, discovers his greatest *happiness in producing masterpieces.*

* A Paper presented to the Lancashire Branch of the Institution of British Foundrymen, Mr. John Haigh in the chair.

Craftsman versus Machine.

The thought of this ideal brings the Author to the chief purpose of the paper, which is to inquire why *love* of craft is not more in evidence to-day in foundries, and having found the reason, to endeavour to find remedies and help in their application. A number of great craftsmen and philosophers of the past have declared that mechanical manipulation would be the death of good craftsmanship. The fact that as the one has developed, the other has declined, seems to bear out that declaration.

Many thinkers of the present day, seeing the position, endorse the declaration. Protests are continually being made against man becoming, as he is in danger of becoming, a slave to machinery. The introduction of mechanical appliances into the foundry has, or ought to have, been with a view to lightening the labour of the craftsman, and in order to put into his hands more efficient tools. If it has not had this effect, something has miscarried, and it is for him as a craftsman to find the reason and set about its correction.

Craftsmanship implies mind; mechanism cannot replace mind, but should be its servant, under complete control. But the day is surely past when laborious toil should be suffered by men, in order to keep them in employment, while means are at hand for relieving them of it mechanically. However injudiciously machinery may have replaced human labour in some cases, it has increased, enormously, the power of the worker and the accuracy of his work. *To that extent its value is unquestionable.* There is every indication that mechanical aids will continue to multiply in the service of man in industry, yet love of craftsmanship must not be allowed to decline.

Can Interest in Craft be Revived?

Is it possible, under modern specialised, mechanical methods of production, for the workers to be really interested in the operation of their daily occupation?

Speaking both personally and for the majority of his fellow-members of the Institution, the Author insists that it undoubtedly is, because we occupy positions in which new problems are ever arising, calling for the exercise of the best faculties of our minds in design, research or execution, and we see infinite vistas of interest in the future.

What most concerns the author at the moment is the application of the question to the rank and file of our foundries. Obviously, under present conditions, their chief interest is the economic one, as it is elsewhere. But it is also evident that if it were possible to interest them more intimately in the qualities of their productions, apart from that, as we are interested in them, their pleasure in their work would be greatly multiplied. This is a feature worth serious consideration. Those who declare " We are not in business for the good of our health " have yet to realise the true purpose of industry and of existence.

If, therefore, no other reason can be found for the wane of interest in one's work than the fact that machinery is making it monotonous and uninteresting, it will be a damaging indictment of machinery, because, after all, the main purpose of industry is *to elevate and improve, not to debase, mankind.* While some blame undoubtedly lies in that direction, there have been other factors of a quite different character working adversely against the love of craftsmanship. These are all the *more potent, because they are human factors.*

Evolution.

In proof of that assertion it is proposed to trace the evolution of the craft of the foundry, because there is much evidence that the primitive foundryman embodied—in embryo—all the elements which have developed into the modern one, as well as some qualities, still wanting, which it is most essential should be restored. Chief amongst these being " *A love of craft and individual pleasure in pursuing it.*"

In attempting to trace the evolution of the foundryman, it is unnecessary to go so far back as mythology or ancient history for a beginning. The 19th century offers us many a good and sufficient starting point. One brilliant example from the 16th century, however, is, because of the spirit of it, well worth our notice in passing.

The Story of Cellini.

The Italian metal worker, Benvenuto Cellini, although a worker in gold and jewellery of the highest genius, had an overpowering desire to produce a great statue in bronze for a public square in Florence. From intricate jewellery to a cast bronze statue 11 ft. high in one casting was a far cry: yet, in spite of many discouragements and temptations to stick to his small masterpieces, which were ever in demand, he persisted in his idea, and the story of production of his "Perseus" is amongst the most fascinating in history.

Cellini had wonderful confidence in his powers of execution. "What man has done, man can do better," was his motto. After experimenting with various earths, he modelled a core of his statue in this special loam, and, after baking it, he modelled the figure upon it in wax, about half-inch thick. This being finished, and further experiments being made in earths suitable for a face-mould, he built this all round his figure, taking special care to provide vents and runners from bottom to top to ensure his casting.

The whole mould being dried and bound up, he dug a pit in front of his furnace, which was also of his own design, and into this he lowered his great mould. He then made fires all round it, which completed the baking and melted out the wax, leaving his mould ready for casting.

Here was the work of years lost, unless melting and casting were successful. His workmen and friends believed it to be impossible. He turned a deaf ear to them all.

The furnace was charged, pinewood fires lighted, when a violent fever seized him, and he could go no further. He instructed his men, went to bed, expecting to die any minute. The men did their best for some time, but the metal, after partially melting, began to set again. They ran in alarm to tell Cellini, who, in spite of fever, jumped out of bed, threw on a few clothes, and ran to see the disaster. He saw the situation, set to work, made the men fly about like imps in fear of their lives, procured special oak wood from a neighbour, threw in all the pewter plates he could get hold of, and fired up furiously.

In a short time the metal began to glow again under this treatment. Now came another trouble. The intense heat generated set fire to the roof, through which the rain began to pour on the furnace, which was again in danger of cooling. Setting his men to see to the roof, he fired the furnace with renewed vigour until at last the metal was sufficiently hot for pouring. He had provided two outlets from the furnace—a new idea in those days—which he opened into the mould. Now came a serious question: Would there be sufficient metal to fill it?

Pouring proceeded satisfactorily, and the furnace was emptied, when it was found that it had just reached the top of the head—not an ounce to spare.

In the excitement the fever had quite left him. After praying and thanking his helpers, who were exhausted, but delighted, he had a good meal with them, went to bed, and had a long and comfortable sleep. The casting proved to be a sound one. Here is a type of the true foundryman of all ages, which is the author's excuse for repeating it. A perfect casting was Cellini's aim. He believed he could make it. He put his whole mind into it, *and did it*. Who would say there was no mystical power behind the craftsman? It is obvious that the qualities of a foundryman include assurance, temper, inventiveness, independence and human nature!

The Modern Evolution.

Apt and interesting as is the story of Cellini and his casting, however, a more commonplace, everyday case will serve to illustrate the evolution of the foundryman. Fortunately, the whole process has frequently been accomplished in so short a time that instances of evolution from birth to maturity are within the experience of everybody. The following is typical.

Two brothers, one a patternmaker and the other a moulder, being animated with a desire to improve their position, and having saved a few pounds, courageously make up their minds to start a small foundry of their own. They have been studious, observant, good workmen, with some pride of craft. They see a local opening for castings of a better quality than those commonly supplied, and which they know they are capable of making. They find a vacant building which they can adapt. Full of hope, they begin work *in good earnest*. Their inventive faculties are soon in full exercise in the preparation of patterns and plant, in scheming to make their limited resources go as far as possible, and in the search for orders. They start two or three men, probably old shopmates, and a few juniors, and the first cast is an event of a lifetime.

They pride themselves on the quality of work they intend to turn out. One applies his talents to the planning of the work, providing patterns, interviewing prospective customers, and attending to accounts; the other sees to the foundry, purchase of materials, and despatch of goods.

The whole of their combined minds, bodies, and estates are put into their business, and it begins to take shape. The first year or two is a severe testing-time with them; things do not always run smoothly. The stuff of which they are made often shows up, and experience of life accumulates at a rapid rate. They live very economically, taking out for home expenses less than they pay some of their workers, but having housewives who second their endeavours, the limited income satisfies their needs for the time.

They encounter some hard facts of business life, of which, as irresponsible journeymen, they had little conception. They are often downcast and near defeat, but having grit, which is characteristic of foundrymen, they win through. This, with variation of details, has been the natural history of the birth of many a successful foundry of the present day. From such a germ the modern foundryman has evolved.

Historic instances of such beginnings are numerous from the time of Abraham Darby of Coalbrookdale, the Walker Brothers of Rotherham, the Tangye Brothers of Birmingham, to living ones within the memory of most. A characteristic of these beginnings was the fact that thorough absorption in the work was almost invariably accompanied with keen enjoyment of it. Enjoyment such as later and *more prosperous years seldom equalled*.

The Human Factor.

Generally speaking, it is the human touch, so active in those early years and so often dormant in the later ones, which makes all the difference.

In those early years the employers are necessarily in close touch with every detail of their work, and this means that they are in close touch with their helpers. They are John, and Tom, and William to each other, and this so reacts on the helpers that they also feel personal interest in the work, second only to that of their employer. They take delight in helping them to solve the problems which arise. What a great asset must such voluntary co-operation be to the budding business!

This fellowship continues for long after prosperity has come to the principals, who generally continue to appreciate the services of those original helpers, and, on their part, the helpers contemplate with pride their share in promoting the success. This human touch may remain between the chief individuals concerned throughout their lives, but in the process of systematising the business in its extending growth, and arranging its scientific administration, this vital element of permanent success—the human element—has almost invariably been overlooked.

In modern foundries many of the elements of the germ have been developed to a high degree. A large and systematic sub-division of labour has taken place. The chemical and physical properties of the materials used have been analysed, formulated, and their properties determined. A formidable literature is accumulating for the students' use, and organisations for further systematic research are busy. Scientific lay-outs of plant, motive power, and mechanical equipment have all

reached a high state of efficiency in these modern organisations. The co-operation of practical experience and scientific research has brought the various operations of melting, casting, and cooling of the metals within sight of definite control.

Staff arrangement, costing, and selling methods have developed into a fine art, and yet with it all something important is lacking. Thus we are all aware of the high stage of development now reached by mechanical and electrical appliances. We are also aware that the more intricate and elaborate the appliance, the more easily is it deranged, and the more disastrous the mischief. This applies exactly to the foundry organisation in its present stage. It is now a complex machine; its bearings are highly sensitive; it needs the finest lubricant in order to give good duty. The most valuable lubricant known is "human goodwill."

The Importance of Goodwill.

Too often does grit of the most mischievous sort —"ill-will"—take the place of the lubricant in the machine, and we are perpetually experiencing the results.

Practical experience and scientific research have, with some goodwill, produced our present complex material organisations—the machinery of the craft. Metaphysical research, equally scientific, when followed with like enthusiasm and adopted as faithfully, will eliminate the foreign matter and ensure perfect and constant lubrication. Research of this kind has been made in odd places with promising results. Wherever it has been pursued, it has pointed to the fact that the study of the human element has been neglected in favour of the less vital material ones.

Some may explain that they do not doubt the importance of the human factor, insisting that there is no dealing with men nowadays. Materials they can regulate. It should be remembered, however, that we can only deal with materials by learning their nature and following the laws which govern them. We are still trying to deal with men by "rule of thumb," often plus self. When we begin the scientific study of men, we shall find it as engrossing as any material science, and perhaps more so. Probably the most useful preliminary lessons will be found in the study of our own minds. There we shall find the problem as well as hints towards its solution.

It is a common charge against the average workman of to-day that his *mind* is not in his work. His physical powers are engaged, but his mind is chiefly elsewhere. There is much truth in this. And for it there are many reasons—some hereditary, some of long growth, some because of defective education, and some because men have been soured by various causes. Some of these reasons are economic—workers are not satisfied with their wages, insecurity of employment, etc., etc. Some reasons are mental—they feel they have no interest in the concern; their chiefs take no personal interest in them; their minds are not wanted; they are not paid to think, only to work. They feel the lack of fellowship; the social and moral link with their employment is very weak. How far are these reasons true? What does our appeal within ourselves say to them?

This mental dissatisfaction is not by any means confined to one class of employees. It is felt, more or less, from top to bottom—from management to labourer—and for very much the same mental reason, *id est*, lack of fellowship within the industrial combination.

The missing factor of "goodwill" is so essential to future development that means must be found without much delay for its recovery. It is not to be credited that men who have, by their combined mental capacity, built up efficient material organisations, such as we now possess, should be unequal to the human duty of evoking the goodwill of their employees, or fellow-workers, such as rendered the efforts of their predecessors so fascinating!

What is required is to awaken the higher faculties of the mind to see the problem clearly. Goodwill may then be trusted to point to its solution. The healthy-minded workman will respond to the call to take interest in his craft as soon as he finds such interest is appreciated.

Many a good craftsman has been soured and made cynical by an unwise remark of a superior inferring "his opinions were not wanted." Instances are common of short-sighted action, which emanate from ignorance and are happily becoming more rare amongst us. The disaffection of the rank-and-file workers with prevailing conditions is not the only mischievous result of the incomplete evolution. The effect on many of those in control is quite as serious. No part of a body can be deranged without all other parts being affected by it. Every industry ought to represent a corporate body.

Were it but realised how much satisfaction is being missed by those in control through the failure to divine how much goodwill lies dormant in their staffs, they would not only take some pains to provide the outlet, but would find in the effort a great source of happiness to themselves, which might transform what had too often been irksome mental drudgery into a fountain of mental recreation and moral satisfaction.

This would also prove to be a safe assurance against the uneasy mental condition which too often attends the years of a man which should yield the ripe fruits of past effort.

Practical Evidence.

There are many indications that the number of high-principled and serious-minded employers and controllers of business organisations is increasing—men who are earnestly seeking means of remedying the mischief they experience. Here is an example. Mr. W. L. Hitchens, Chairman of Messrs. Cammell, Laird and Company, in his "James Watt" lecture in 1918, says: "Unless industry is really recognised as primarily a national service, in which each individual is fulfilling his function to the best of his ability for the sake of the community, in which private gain is subordinated to public good, in which, in a word, we carry out our duty to our neighbour, unless we build on this foundation, there is no hope of creating the House Beautiful. If each man thinks of making his pile by all the means that economic individualism allows, if class bands itself against class, trade union against employers' federation, firm against firm, to secure the greatest share of the world's goods in unrestricted competition, social life must inevitably break down and anarchy reign supreme." These are basic truths of business, social and national life. Many similar expressions made recently by highly-placed men, if followed by action, give promise of a brighter future.

While the foundry, like other industrial concerns, is not without those to whom money-making has the strongest appeal, it contains many who are prepared to respond to the higher calls of public service and commercial well-being.

Want of thought, even more than want of heart, has been responsible for the prevailing disaffection. While the employer has been occupied with many matters in the building up of his business, the breach has been imperceptibly widening.

The craftsman has noticed the success of his employer, and that his own position has remained fixed and precarious, and his spirit has revolted against conditions which seemed to him unjust.

Influence of Mass Production.

Thus has the ground been prepared for further disrupting suggestions, sometimes as unwise as they were untrue. In the meantime, there has grown up a large class of men of narrow nurture and outlook, whose goodwill has never been fostered, but who have been peculiarly susceptible to the seeds of ill-will, which have blown about in every wind.

In the evolution from the small to the large unit of production it is impossible, of course, to maintain the intimate touch between individuals which was quite easy in the simpler unit. But just as the physical elements have been adjusted to the larger purpose with advantage, so it is possible to adjust the human relations, and to equal advantage to all concerned.

The scientific adjustment of the latter is of *first* importance at the moment. Material success and social harmony depend on the realisation of absolute *interdependence* between the various units of the organisation. Too long have obvious facts been ignored, with disastrous results. The lessons of the last few years have been hard ones, and it

will be harder still if we fail to profit by the wisdom which they contained. The large production units, with their necessary sub-division of duties, have rendered the work of almost everyone, from managing director downwards, more uniform, and, to active minds, more monotonous than the original methods of production. To how many a man, who has risen from craftsman to managing director, has the routine of signing cheques, going through tables of costs and production sheets, and taking part in interminable wages discussions, proved as monotonous as the ramming-up of so many boxes per day to the moulder!

How often he has yearned for more freedom to spend time in shop or drawing office at his favourite occupation on new or improved devices! This is stated with definite knowledge.

This being so renders it all the more necessary that the common tie which binds the employer to his helpers, and they to him, should by some means be made all the stronger and all the more cordial, so that their joy in common service may be complete.

Peace and War.

If it was a great thing to go through the mud and blood of the trenches in the service of one's country against a common enemy without thought of loot, and if it was a grand thing to lead men in such an adventure, and to be proud to chum with them and to be proud of them—is it not as great a thing to serve one's country in making useful things—in the sand heap, at the cupola—or in the pattern shop? And is it not as grand a thing to "captain" and "general" such rank and file in the service, and to chum with them?

Every fine fibre of healthy minds declare that it is. Ought we not to set a high value on our own particular bit of the service, and to look through the drudgery and the discomfort to the nobility of it? We might well think of it, not as something which is merely tolerated for the money it brings us, but as the means through which we have learned the lesson of life, and through which we express our service to our fellows; and, therefore, as embodying the best expressions of our nature.

The problem is left for foundrymen to turn over in their minds at leisure. That it is engaging many of our minds is evident in the Presidential addresses of the Institution, the latest instance of which may be found in the report of the Proceedings of the Annual Convention of 1921.

(To be continued.)

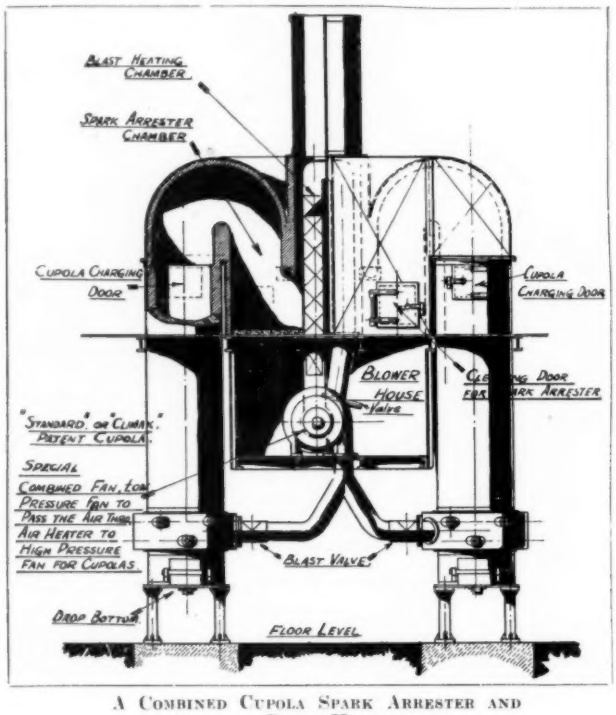
An Innovation in Cupola Design.

By E. ROPER (*Keighley*).

The illustration below shows a combined spark arrester and blast-heating arrangement which has been applied to one of Messrs. E. Roper & Company's melting units. The cost of this improvement is little more than the cost of adding a spark arrester to a cupola. The advantage shown is that the sparks are arrested at the platform level, where they can be easily and cheaply removed, a considerable saving as compared with an arrester fixed at the top of the cupolas.

This plant has been designed to meet the need for increased efficiency by utilising the waste heat from the cupola after passing the spark arrester to heat the blast, thereby reducing the coke consumption per ton of iron melted, and the chilling of the slag. These improved working conditions are claimed to increase the speed of and lower the cost of production.

The combined spark arrester and blast heating arrangement is formed in a rectangular chamber fixed at the side, or in between the cupolas—where a pair are working side by side—connected to the top of these, and either supported by them or on the charging platform.


BLAST HEATING CHAMBER
SPARK ARRESTER CHAMBER
CUPOLA CHARGING DOOR
CUPOLA CHARGING DOOR
BLOWER HOUSE
Valve
"STANDARD" OR "CLIMAX" PATENT CUPOLA
SPECIAL COMBINED FAN, LOW PRESSURE FAN TO PASS THE AIR THRO' AIR HEATER TO HIGH PRESSURE FAN FOR CUPOLAS
BLAST VALVE
DROP BOTTOM
FLOOR LEVEL

A COMBINED CUPOLA SPARK ARRESTER AND BLAST HEATER.

The cupola proper terminates at the top of the charging hole as shown in our illustration, which shows the arrangement attached to a pair of cupolas, but it is equally applicable to single cupola plants.

A complete arch forms the spark arrester, which deposits the sparks at the platform level in the side chamber, and a door is provided for their removal, the blast heating arrangement being fixed in the central chamber, or beyond the spark arrester.

The blower house is fixed beneath the platform immediately under the above arrangement, and the blast is blown through the heater in the air heating chamber. This is supplied by a special combined fan, a low-pressure fan blowing the air through the heater to the inlet side of the high-pressure fan which supplies the blast to the cupola or cupolas.

With this blast arrangement a positive supply of air is assured, as the high-pressure fan is not required to force, or induce the air through the blast heater. It also gives independence of action to the fan, which can continue to work, either with or without the air-heater in operation, thus eliminating any danger of a stoppage of the cupolas during melting.

Institution of British Foundrymen.

NEWCASTLE BRANCH.

Discussion on Mr. Smalley's Paper on Volume Changes of Cast Iron on Solidification.

THE CHAIRMAN (Mr. H. J. Young), in opening, said he thought that Mr. Smalley's Paper was extremely practical, and ought to raise many points for debate, most people having had their difficulties with regard to rate of pouring. They were all greatly indebted to Mr. Smalley for his Paper, and it was their duty to encourage him by criticising it and telling their own experiences. He had seen a great many castings with blow- and draw-holes in his time, and he was sure that everybody would be grateful if Mr. Smalley could help them to eliminate some of these deficiencies.

Chilling Stuffing Boxes.

MR. PAULIN said that he could not seriously undertake to criticise such a lengthy Paper containing so many splendid points, but he wished to express his admiration of Mr. Smalley's Paper, which must have involved so much work. The lecturer had referred to the fact that it was the belief of many foundrymen that the insertion of a chill in the neighbourhood of a thick place, where the section was swollen, only removed the sponginess to a further distance. He (Mr. Paulin) had understood the lecturer to say that it really eliminated it, but in one of the sections shown on the screen he had noticed the same effect, namely, distinct solidification to a greater distance and the re-appearance of that sponginess.

He understood from Mr. Smalley's experiments that phosphorus from 0.1 to 0.6 per cent. did not affect the volume charge on cooling. It was quite evident, he thought, that the shrinkage was greatest when the temperature of the mould encouraged the retention of heat. The mould made of ganister being hot just before pouring rather upset, he thought, the permanent belief in the dry-sand moulds, and it seemed that green-sand was going to be well worth research in the future. His own method of putting a chill in the hole of a heavy boss had always been considered an absurd proposition, but nevertheless it acted successfully. With regard to the sketch which Mr. Smalley had shown of the stuffing box, he would like to know why the chill was put on the outside in preference to the inside. He felt rather doubtful as to whether a very large quantity of metal could be run through so small a gate as mentioned by Mr. Smalley, and whether it would not carry away with it a certain amount of sand into the casting itself.

Railway Chairs Cast without Risers.

MR. FRIER thought that Mr. Smalley's Paper had left everyone thinking, and that there were really too many points to follow out in the short time. It was apparent that a great deal of time and trouble had been spent on the experiments. He said that years ago castings had been made without risers; for instance, heavy castings such as railway chairs were cast with an ordinary gate about 1½ in., and there was no shrinkage after the castings were turned out. He believed that in ordinary railway chair foundries the iron was fairly close-grained, and not altogether noted for strength, owing to the phosphorus-content being very high. Years ago they used to make very heavy castings with about eight bosses on the tops, and with large risers, but these did not always fulfil the purpose for which they were made, the trouble lying in the fact that the riser would probably shrink. Since then, however, he had dispensed with the risers, and ran the metal at one end, putting an ordinary riser off the joint at the other end, with the result that they had not had a drawn boss since. He had made other castings without risers, both with success and without success. He thought that if a fairly heavy casting, something similar to the cubes which Mr. Smalley had shown on the screen, was run from the top it would probably be more solid than if run from the bottom, providing that the runner was not too large, because as the metal was entering the bottom of the mould it was solidifying and feeding until it got to the top.

Risers.

If there is a riser at the top, the section of the riser next to the casting was not in proportion to the size of the casting, therefore it would solidify more quickly than the casting, and the result would be holes in the top part of the metal. If the casting was fed from itself naturally it would not be fed from the head, and he had found that if a heavy section was cast with a 1½-in. riser from the joint there was no shrinkage on top of the casting.

Marine Engine Castings.

MR. JAMES SMITH said that he had listened with interest to Mr. Smalley's Paper, but did not agree with all the points therein. He was referring particularly to the running of castings, and Mr. Smalley apparently thought that they were better run from the top. He remembered that a few years ago marine engine castings were all run from the top, but it was sometimes impossible to get the cylinder bore clean because the small risers were apt to dribble onto the casting. When making two intermediate cylinders for a boat a few years ago on which there were double crowns, with one crown projecting 2 or 3 in., which made it impossible to get the runner down through the bore of the cylinder, it was rather a problem as to how to run the cylinders, but he eventually decided to run them from the bottom. When they were made and machined, they were essentially clean, more particularly in the feet and top. They did not altogether abandon the ordinary running of cylinders, but just tried running small ones from the bottom, but now they never cast a cylinder from the top. His experience had been that when cast from the bottom cylinders were much cleaner than when run from the top, providing they were run quickly.

Slow Pouring.

If a bedplate, say, 20 ft. long by 10 ft. broad, weighing from 15 to 16 tons, was cast slowly, the metal would be cold before the mould was filled, therefore it would have to be run with sufficient rapidity to enable the metal to unite until the mould was full. Sufficiently quick running also prevented cold shots, and he had seen castings which were faulty owing to the metal being cast too slowly.

Feeding Castings.

It might be true that with a certain mixture of iron a fairly thick job could be cast without feeding, but if he was given a mixture of iron for a propeller boss weighing, say, 4 tons, and told to cast it without risers and without feeding he would be nervous until the job was finished and proved to be correct. His contention was that all iron should be fed, irrespective of the mixture, because there was bound to be a hollow part. If when the liquid metal was brought from the furnace and poured into the mould the job was not fed, the top of the riser head would be found to be hollow. He would like to ask the lecturer if, when casting a bedplate or a cylinder, he would run it slowly or quickly. With slow running the chances were that the scum rising from the metal would adhere to the outside or inside of the casting.

Railway Chairs.

MR. R. O. PATTERSON (past Branch-President) said that he had listened with great interest to Mr. Smalley's Paper. With regard to the quality of iron in railway chairs, he thought that Mr. Frier must have been speaking of many years ago, because he (Mr. Patterson) could assure him that nowadays railway chairs have to undergo tests equal to, and even more severe than, a good many castings made on Tyneside. With reference to the question of gates on castings, he had gathered from Mr. Smalley's remarks that he believed in small gates, but that the metal should not be run particularly slowly, and it appeared to him that Mr. Smalley wanted hot metal to run at a rate proportional to the size of the casting, so that the critical cooling rate (which he seemed to think so desirable) was obtained.

XUM

A Plea for Conservatism.

MR. MATHEWS thought that Mr. Smalley's Paper certainly contained a lot of new ideas. Everyone was familiar with the elimination of blow-holes by means of risers, feeders and heads. He did not think that foundrymen should discard their present practice with regard to feeding until they were more sure of the new practice. His contention was "stick fast to the old methods until it had been proved that the new methods are as good."

MR. CARR said with reference to the question of a sound casting being made in a chill, he concluded that it was partly due to pressure caused during solidification of the casting. It sometimes occurred that the top of the top box was 6 in. above the casting, and sometimes 18 in., and the pouring basin was still put on the top. Could Mr. Smalley say if by increasing the pressure on the mould, by raising the height of the pouring basin, it would be an advantage to the casting?

Slow Pouring and Sound Castings.

MR. S. W. WISE (Senior Vice-President) said he did not think it was an established fact that castings run from the top were the best, because he considered that the nature of the casting had to be taken into account. He had found, when casting fly wheels, for instance, that it was possible to get a more solid casting by putting small runners on the top than if the casting was run from the bottom and fed. On the other hand, they obtained better results when casting complicated castings by running them from the bottom. In the casting of cylinders from which gases had to be released, slow pouring would help, providing that the metal was sufficiently hot to produce a sound casting. With regard to bottom pouring, they had always found that they obtained better results when a number of cores were present by running from the bottom, but for gunmetal liners better results were achieved by running from the top. With regard to the size of gates, he agreed that the smaller the gate the better, providing, of course, that the metal was hot enough, because the more slowly a casting was poured the sounder it would be. He thought that Mr. Smalley's Paper was perhaps a little above the head of the average man, but the time had come when it was most necessary to have investigations of this kind and for men like Mr. Smalley to investigate things from a metallurgical standpoint and to point out the many difficulties.

Importance of Manganese.

Before asking Mr. Smalley to reply to the discussion the BRANCH-PRESIDENT said that it was impossible to criticise this long Paper from the scientific point of view after merely hearing it read, but it was very evident that Mr. Smalley had done a large amount of work. It was really wonderful that he had been able to conduct so many experiments and put them forward in such a manner. A point had arisen in the discussion about new ideas, but he (Mr. Young) considered that foundry work badly needed new ideas. The foundry trade started with a very few ideas, which were gradually worked up into the modern foundry practice, but it was not to be forgotten that some points might have been missed. If the world was started over again modern practice would probably be different from what it is to-day, and they might be making castings in the same way as Mr. Smalley is making them, and on the other hand Mr. Smalley might be telling them about castings made in the same way as they themselves are making them, and so everything might have been reversed if things had been started on different lines. People must not think because ideas are new that they are not practical ones. With regard to experiments, he considered that the only way was to try things on a small scale, and so get ideas about them. Referring to composition, he had noticed that Mr. Smalley hardly mentioned manganese with regard to crystallites and the sizes of crystals; but did he not think that manganese was quite as important as, if not more so than, silicon? It was becoming common practice to use low-silicon irons, and he thought it was possible that they were using irons with lower silicon-content, and probably lower phosphorus-content, than were used years ago.

He would like to ask if some of Mr. Smalley's casting temperatures were not rather difficult to obtain in ordinary everyday foundry practice, and whether they could be attained every day without fail. He would read the Paper in print before entering into any actual scientific criticism, and in conclusion wished to express his admiration of the Paper, which he thought was one of the best he had heard.

THE AUTHOR'S REPLY.

MR. SMALLEY said, in reply to Mr. Paulin, that the section referred to was chilled on the sides only. Because the rate of cooling was slower than the "critical rate" referred to in the lecture, there was a draw at the change of section. When solidification was speeded up, however, by chilling the top and bottom as well as the sides, the draw was not only eliminated, but the sectioned bedplate was uniformly solid.* He had stated that "at one time" the foundryman thought that the chill merely displaced the draw from one place to another. As the illustrations show, this is not so, but completely eliminate it if a sufficiently rapid solidification is obtained.

Effect of Phosphorus.

His experiments had shown that liquid shrinkage is unaffected by the quantities of phosphorus stated. He did not wish to imply that phosphorus content was therefore unimportant in regard to the "feeding" of castings, or that it may be dispensed with. Phosphorus gives rise to a low melting-point phosphide, and thus extends the "range of solidification" of cast iron. Because of this, it is commonly responsible for defects such as drawholes and sponginess in castings of varying sections or of large bulk. On the other hand, phosphorus has its value. In many respects it is to cast iron what tin is to bronze, and whilst one may have actual data on "liquid shrinkage," a knowledge of the other factors involved in the mechanism of solidification is necessary for its successful application. As stated in the Paper, there are three principal forces operating during solidification of cast iron in the mould: (1) Expansion or contraction, or both at the same time in the case of complex castings; (2) crystallisation; (3) liquation.

Teeming Speeds.

Fig. 55 shows how a coarse, loose texture is obtained by filling a mould quickly, which structure facilitates liquation. Other illustrations show how by forcing the same metal through a small jet and filling the mould slowly, the large dendrites of the primary crystal grains are broken up and permit of a closer packing of the crystal grains, which, incidentally, minimises liquation. Similarly was it shown that rapid cooling also breaks up these large crystal grains, and is even more effective in closing the grain. Again, running slowly minimises liquid shrinkage by gradually feeding up as the iron solidifies, but again "rate of running" must be considered, not only with the rate of solidification, but the range of temperature through which the iron solidifies, i.e., with the chemical composition of the iron.

Risers.

With reference to the rate of cooling, the experiments had shown that drawing increased as the rate of cooling decreased; consequently the section of a riser at the casting should always be less than the section of the casting, or that position of the casting would invariably exhibit a more open texture than the rest of the casting, due to the slower rate of cooling.

He was interested in Mr. Paulin's remarks regarding the use of chill cores in cylindrical castings, and strongly supported him. In casting marine pistons, for example, he always used a solid steel core. This could be knocked out quite readily when the casting was cooled down to a dull-red heat. Such chills always strip cleanly. He did not recommend grey cast-iron chills for this purpose, owing to the risk entailed in stripping; it was cheaper in the long run to use steel. In the case of the small stuffing-box referred to, it was more economical in this instance to use external chills

* See Fig. 48, p, 98.

Sand Erosion.

There is little trouble in this respect if the jets are skilfully made and a suitable sand is used. In machine-mould work it is desirable to fix the runners on the pattern plate; where this is not possible, the jet should be strengthened by sprigging, or made by means of hard-sand cores. The latter is essential if the "slit jet" is used. This is one of the most efficient means of running clean castings from the top without feeding risers. It may be applied to almost any form of casting. A simple plan is to ram two small slabs of baked loam in the runner basin, or to hack-saw the slit through a cake of loam about 1-16 in. wide. With this type of runner, as with all jet running, cleanliness and care is essential; dirt and loose sand must be avoided, or the jet will be choked. In the case of the slit jet, this must be increased in number or length to suit the form and size of the job.

In regard to the sand, care should be taken to see that it possesses the requisite properties. For green-sand work, he used a synthetic moulding sand made to certain physical constants, viz., bonding strength, permeability to gas, texture, moisture, and coal-dust content. The sand contains 20-50 per cent. of sea sand, according to the quantity of coal-dust, and milled so that a constant bond and permeability is obtained, irrespective of the quantity of coal-dust it contains. The quantity of coal-dust is a very important feature, and is varied according to the section of the casting, e.g., for thin castings, 6 per cent. is used: for castings 2 to 4 in. section, 15 per cent. is used; and for castings 4 to 7 in. section, 25 per cent. is used.

Value of Experience.

The lecturer thanked Mr. Frier for his remarks, and said that he had not attempted to make dogmatic assertions, but to establish principles for the production of castings. As replied to Mr. Paulin, phosphorus has its value in cast iron, but phosphoric irons must receive special consideration. For many purposes in a jobbing foundry it is safer and cheaper to use a high-phosphorus iron and counteract the ill-effects of crystallisation and liquation by either modifying the method of running or rate of solidification. He was interested in Mr. Frier's remarks upon the dimension of risers and of making castings without risers. One could not belittle long experience, and there is no doubt that the art of making castings a hundred years ago was equal to that of to-day, but nowadays things are run on different lines, and if a man is to meet the severe competition of to-day, he must establish scientific principles, and work from those principles, instead of using the casting itself for experimental purposes. With regard to running from the top, the thought Mr. Frier had misunderstood his remarks, which were only intended to apply to jet or slow running; he did not think jet running from the bottom was a commercial proposition in a large jobbing foundry.

Practice and Science.

When men with Mr. Smith's years of experience gave their ideas, he (the lecturer) always received them with the greatest respect, because, so far as scientific knowledge went, a man of trained observation, and with the knowledge and long experience of Mr. Smith, was as much a scientist as the man who may have studied chemistry.

With regard to the method of running marine cylinders, he did not suggest top running. His own method of running such castings was from the bottom until about two-thirds full, and then from the top, so as to lift any dirt from about the bore.

Bedplate Castings.

For the 16-ton bedplate which Mr. Smith had mentioned he did not recommend jet running. For such a casting he used an ingate area of 0.16 sq. in. per cwt. of metal. The mould filled in two to three minutes. If the metal was on the cold side, he recommended the use of a flow-off riser. Personally he had not encountered spilliness or cold shuts or such defects from cold metal in this form of bedplate by the rate of running mentioned.

He thought that the propeller-boss casting referred to was one of the most difficult castings. To cast a solid block of metal 4 to 10 tons, which had to machine cleanly and be solid on every face, was a problem, he knew, and to say whether it was better to run it from the top or from the bottom was more than he would venture. When casting such a block, his procedure was to run slowly from the top and arrange to cast with a feeding head, which cools slower than the block, e.g., in the case of a 6-ton propeller-boss, the faces and angles of the boss are lined with 2-in. chills, and a head placed all round of suitable dimensions. In closing up, he tried to arrange for the top head to be put on the mould at a higher temperature than the rest of the mould. On this head, the runner basin is fixed, in which four ingates, 3 in. × ¾ in., are cut, so that the mould fills slowly and feeds itself as it solidifies. A metal of short range of solidification is aimed for of the following composition:—C, 3.00; Si, 1.25; Mn, 0.8; P, 0.30; and S, 0.06 per cent.

Similarly could the jet experiments outlined in the Paper apply to any large mass of metal, the essential points being to use an iron of short freezing range, and run as slowly as possible, with hottest metal at the top. For castings up to 10 cwt., the 1-16-in. slit is the most useful size, varying in length or number of the slits to suit the casting. By this means it is possible to procure clean and solid castings most economically.

Feeder Heads.

He had not made any condemnation of feeder heads, because they have their uses, and always will have; but every casting presents its own problem in this respect. When in doubt, he recommended the safer plan of using the riser or feeder head.

Head of Metal v. Solidity.

In reply to Mr. Carr's query, he said that most foundrymen were of the opinion that the greater the head of metal, the more solid the casting, due to the proportionately increased pressure. There was no evidence to prove that this was so; for example, in the case of a hydraulic cylinder, density determinations made from sections cut from both the top and the bottom, had shown there was practically no difference. Again, a flat plate of similar section, cooled at the same rate, cast with practically no head from the same ladle of metal, exhibited a similar solidity and density. He would not say, however, that there was no advantages to be gained by increasing the height of the down gate, *e.g.*, it may tend to give better definition, or, just as the pressure of gas in a syphon of soda-water prevents the escape of the gas in the form of bubbles, so may an increased liquid pressure prevent blowholes, although this is questionable in the case of common grey iron.

He was very interested in Mr. Wise's reference to methods of running There is no question that the best method of running a complicated casting containing delicate cores was to obtain a straight uninterrupted run of metal, and the question as to whether top or bottom running was preferable could only be decided upon after due consideration of the factors involved in the production of that casting.

How Manganese Influences Cast Iron.

He was very interested in Mr. Young's philosophy. He (Mr. Smalley) had outlined a series of experiments to demonstrate principles of direct application in production of castings, and to show how, by these experiments, it was not necessary to make the first casting an experimental one. He had not mentioned manganese content in the lecture owing to the difficulty of referring to each chemical element. He certainly agreed with Mr. Young in regard to its order of importance. Throughout these experiments the manganese content was maintained about 0.75 per cent., which is his practice with ordinary grey iron. In the case of semi-steel, a higher manganese is preferred, 1.0 to 1.2 per cent. The question of how manganese affects the crystallites, he continued, was a complex one. One had to consider sulphur at the same time. Mr. Young had done good work on the sulphur-manganese balance, and he (the lecturer) said it was of the greatest importance to all foundrymen at the moment. In regard to manganese and the crystallites, however, it is difficult to say how it does affect their growth, as both manganese and sulphur exert a similar action in the

absence of each other, but the extent to which they counteract the action of one another, as in ordinary commercially-melted grey iron, is a research in itself. He would say, however, that sulphur was far more active than manganese, so far as production of dendritic structure is concerned.

Casting Temperature.

With regard to the measuring of casting temperature, he had found it necessary if one was to attempt to standardise cupola operations. In commencing this they had found, under apparently similar conditions, it was possible to get hot metal (1,380 deg. C.) one day and cold (1,300 deg. C.) the next day. To be able consistently to produce hot metal is essential to any foundry, and the insertion of a thermo-couple is the only reliable method of ascertaining the differences in temperature of the daily melt.

After a vote of thanks to the lecturer, the meeting closed.

How Moulders are Paid.

As there appears to be several systems of payment by results, and each firm has its own interpretation of those systems, it would be well to consider each method with a view to discover that which works to the entire satisfaction of employer and employé.

First let us see what is the main principle. It might be summed up in a very few words.

A definite amount of work completed for a definite amount of money paid, with the desire to increase production and increase wages.

Foundry work differs so widely from other trades that any system of payment by results becomes increasingly difficult to work smoothly and satisfactorily. The ability of the craftsmen is not uniform, the price fixed for one moulder would most certainly not be just to another.

The vexed question of defective castings and who shall pay for them is always embarrassing, and sometimes leads to rupture of good relationship, or perhaps the dismissal of the workman. The fixing of rates is also a very trying matter, and usually requires keen judgment to arrange satisfactorily.

"Smith" is a very ordinary workman, and is given a piece of work at a price which will allow him—by extra exertion—to earn time and a third. Try as he will, he cannot reach this standard, and is scarcely able to pass his day rate, so altogether, the extra energy demanded and the risk of defective castings involved, he becomes very disheartened, which generally ends in his leaving the shop or getting discharged, and his workmates nearly always sympathise with him, thus causing discontent throughout the foundry.

"Jones" is a very good workman, and is given the same job as "Smith" at the same price. By his ability he can easily earn double time, and have less risk of wastage, yet some shops rule that he must not earn more than time and a third, so he has to slack off. Therefore this system tends to restrict output. The rate-fixer tries to overcome the difficulty by drawing a line of demarcation between Smith and Jones, and alters the price so that "Smith" can earn time and a third by increased price, while "Jones" can only earn time and a third by decreased price. "Smith" is very satisfied with his improved prospects, but "Jones" is far from being happy, because he knows perfectly well that his ability is penalised. By this it seems that a fixed price cannot prevail throughout the foundry. Perhaps a little consideration should be given to the slow workman, but most assuredly the fast workman should not be penalised.

Fellowship.

This is a system in which the whole of the employés participate, and it works very well in large foundries, where one piece of work engages several moulders for many days, and where the nature of the work is constantly changing. Generally speaking, the price is fixed at so much per ton all round finished castings over the scale. If the actual labour cost of the castings turns out to be less than the price fixed, the difference is paid to the employés according to their rate.

It is quite possible to have perfect harmony in the foundry, and all therein may be actuated with the honest desire to do their best, but there is often the feeling of distrust. Some say they never know how much they are going to receive until the month's work has been despatched. Additionally, they have no knowledge of how the system is worked, having no means of keeping a check upon the output or the manner in which defective castings returned are put against them, and there is always the irritable feeling that some of the workmen are not doing their best, but are still participating in any surplus earned collectively, and the good craftsman feels that he is carrying the ordinary workman all through.

Premium Bonus.

Here there is a system which can be worked individually or collectively, and is approved by many, particularly those firms where difficulty is experienced in fixing piece work or fellowship rates. In such cases this system is resorted to, being much easier and more simple than the two already mentioned.

The method works in this way:—A price is fixed for each article or per ton, and if the actual moulding cost falls below this figure the difference is divided between the employer and the employé, each taking 50 per cent.

Piece Work.

This is perhaps the most satisfactory of all methods, certainly so to men of ability. They know the price agreed upon, they also know their own capabilities, and it is entirely in their own hands what money they earn, providing they are not restricted to time and a third. As some firms have a custom of retaining all money over time and a third, such money is held until the moulders do not earn time and a third, then it is used to bring the wages up to time and a third.

German Aluminium Industry.

The British Commercial Secretary at Berlin (Mr. J. W. F. Thelwall) has forwarded to the Department of Overseas Trade some notes on aluminium, which appeared in the German daily Press.

Special mention must be made of the prejudice which exists against aluminium in Germany, which is despised by German managing directors, even those of the Reich railways, who still prefer copper and zinc. A consultative department has for long existed within the Metal Industry Union for the purpose of advising industry in regard to the substitution of this light home product for foreign metals. Although the results of the propaganda by this department have been important, the capacity of the German works unfortunately still cannot be taken advantage of, even to the extent of one-half, because of the small demand for aluminium. The yearly consumption is only 12,000 tons. A good deal of raw material for the manufacture of aluminium still remains over in Germany from former years; this consists partly of Istrian-Dalmatian ore. From the Vogelsberg beds about 20,000 tons of ore are obtained yearly, while the good quality bauxite delivered by France varies in quantity according to the fluctuations on the Stock Exchange. As about one-fifth at least of the earth's crust consits of alumina, the major portion of which is contained in clay, the prospect is offered to become independent of foreign metal supplies.

Shortly after the armistice a good deal of aluminium was exported, but for some time past the export has been prohibited. In the meantime, however, the Aluminium Company of America succeeded in getting the import duty on aluminium raised to 33 per cent. of its value; similarly, France has protected her industry against Swiss and German imports by an *ad valorem* duty of about 50 per cent., and the possibility of exporting to England scarcely exists since the anti-dumping legislation. The new German industry has very powerful competitors to fight.

XUM

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Volume Changes of Cast Iron on Solidification.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I desire to state at the outset that the following remarks are in no sense a criticism on Mr. Smalley's research and findings, but more in the form of appreciation of a valuable work for which all foundrymen will feel that they owe a debt of gratitude.

Mr. Smalley is one of the very few who have attempted to solve the underlying principles which govern a real foundry problem under usual foundry conditions.

The writer having passed through the "mill" for many years in a large foundry, endeavoured to solve some problems which have increased with the progress of engineering and the demands of the engineer for castings of more complicated design and the like. The writer, before 1912, spent much time in experimenting and close observation on the subject of liquid shrinkage with irons of different composition, and the result of this work, although crude and inconclusive, appeared in THE FOUNDRY TRADE JOURNAL in April, 1913. This matter may not be very profitable reading now, but it must be remembered previous to that time little interest had been taken in foundry problems of this nature, except by a very few. In this respect I refer now to research work being carried out under ordinary foundry conditions by metallurgists.

Temperature Balance Reaction.

Regarding the experiment outlined in Fig. 14, Mr. Smalley will realise that the results obtained might have been different if the area of the runner-gates had been increased with the fall in the temperature in the metal.

Minimum Rate of Casting.

The Paper states that any grey iron cooled during solidification slower than a minimum rate prevents shrinkage flaws which can be completely eliminated by speeding up solidification. I am in entire agreement with that. For many years the difficulty has been in speeding up solidification sufficiently to ensure uniform quick cooling with intricate castings of exceptional design.

Permanent Moulds.

Reference is made to permanent moulds producing sound and solid castings, and sand moulds producing porous and drawn castings. The comparison I know is made for a good reason. Cooling changes take place in a sand mould that do not occur in a permanent mould. The sudden cooling in an iron mould appears to bridge over the possible critical arrest changes that occur in a slow-cooling sand mould. In cast iron, however, permanent moulds are only adaptable to very simple castings.

Transference of Draws.

I was unaware that it was a common belief that chilling in the form of a permanent mould transferred draws to places in the casting where they are not noticeable, which is a very different matter from applying loose chills on certain parts of castings the design of which may be equal in section, except at the junctions, which remain much longer liquid than the other parts of the casting. This is a problem as yet untouched. Let me make myself more clear.

If reference is made to an article by the writer which deals briefly with chilling in loam and sand work, published in THE FOUNDRY TRADE JOURNAL, July, 1914, an instance is shown where the largest chill possible was used, failed to remove the draw, but reduced and transferred it; its existence could only be found by drilling or fracturing.

I wish to refer to other two short articles which appeared in the JOURNAL, July 6, 1922, under the caption "Cylinder Heads," and October 5, 1922, "Steam Chests." The question raised in these two instances was not so much a matter of thick and thin section, as partitions of metal enclosed in the outside sections of metal, thus keeping the internal walls of metal in a liquid state much longer than the other parts of the casting with the inevitable consequence of porosity. If these articles are referred to it will show to what length the writer went with chills in the attempt to eliminate the trouble before resorting to feeding.

Risers.

In many cases the putting of risers on castings has become a habit with moulders, and often these are quite unnecessary, and possibly do more harm than good. There are exceptions, however, for instance, where an indication is needed that the mould is full of metal, also as escapes for trapped air, and a receptacle for dross.

The risers placed on castings A and C of Fig. 35 were quite unnecessary, and would induce a shrinkage hole underneath the riser unless fed properly with a rod. This statement also applies to Fig. 46

The casting represented by letter B (Fig. 35) is quite another proposition, *i.e.*, substituting hard iron in place of soft iron; this will be referred to again. Letter D (Fig. 45) is an instance where the runner ingates on being altered improved the solidity of the casting. This aspect is very important, and is supported by the writer in a short article appearing in THE FOUNDRY TRADE JOURNAL, September 14, 1922, under the caption of "Oil Cooler Castings." There are numerous instances where the distribution of small runners in place of large ones have entirely eliminated the porous and drawn places, which is due to a more uniform cooling.

Top Pouring.

A brief reference to Fig. 37 is of special interest. I take it the casting is a 6-in. or 8-in. cube, and the top runner is a ¼-in. square. Some surprise was expressed that the mould filled. I would point out under those conditions it was almost as easy as filling an open sand mould and the explanation is simple. A runner basin almost as large as the casting was used, the mould was probably dry sand, or the top part would be, and according to sketch about 3 in. of sand or less would be between the bottom of the runner basin and the top of the casting. A 2-in. diam. recessed opening in the centre of the basin bottom coming within one inch or less of the top of the mould when pouring, the basin would be kept nearly full of a high temperature iron, approximately 1,450 deg. C. The weight in the basin, coupled with the very hot metal, would keep the small runner open during pouring, hence the cube would be practically poured under pressure. In ordinary foundry practice it is surprising what a large amount of metal will pass through a ¼-in. round vent hole under pressure as when a mould is full.

I am in thorough agreement with the author's conclusions as to top pouring, as recent articles in the JOURNAL upon large vertically poured castings will show.

The pouring-jet area in relation to the total weight of the casting has been given as 0.05 sq. in. per cwt. To apply this method to propeller bosses may be quite a success, and is often very nearly approached in present practice, but to apply it to a bladed propeller would be an entirely different matter.

If hard iron, dazzling white temperature, narrow range of fluidity, jet runners and slow pouring, eliminate liquid shrinkage and draw cavities, then I agree with Mr. Smalley's statement: "To disregard any of the precautions outlined will find the foundryman confronted with defects which more than counterbalance any advantage gained in solidity."

In this research, Mr. Smalley has used terms such as temperature balance reaction, degrees of superheat, minimum critical rate of cooling, etc.; these should be made so simple that the man in the foundry can understand.

Personally I feel indebted to the author. I have read and re-read the Paper several times with increasing interest. I think it should rank as a foundry classic work upon liquid shrinkage, or contraction of cast iron.

Yours, etc.,

S. G. SMITH.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I expect yourself and the author of the excellent Paper on "Volume Changes of Cast Iron on Solidification" are hoping that many foundrymen will enter into discussion through the medium of THE FOUNDRY TRADE JOURNAL, and so

endeavour to further elucidate the vexed question of pouring and feeding. There is an enormous field to cover, and the Paper proves this from the amount of detail in it. Also you are to be congratulated on the fine reproduction of the etchings.

Does Hot Metal and Small Runners Equal Cold Metal and Large Runners?

I have a few questions I should like the author to reply to. Does he not think that casting hot with a small runner is somewhat the same as pouring cooler with a larger runner? To me it seems that the solidity or soundness of cast iron depends somewhat on the rate of cooling.

This is always affected by the class of material of the mould, so that pouring hot metal through a small gate into an iron mould would give a similar effect as pouring cooler through a larger gate into a sand mould.

This seems to be proved by the experiment with the ganister mould at 300 deg. C. If it had been poured very slowly it would not have shown so much "draw."

This seems to prove that the soundness of castings very often depends on the heat conductivity of the mould, and not so much on the size of the runners. The effect of small runners is to fill the mould with liquid metal, but only just as fast as the mould can conduct the heat away.

So that with a small runner on a cast-iron mould also on a sand mould, the iron mould will give the soundest casting.

Coming very near a scientific proposition, a mould should be poured at a temperature and time just sufficient completely to fill the mould with the liquid metal.

This would differ for all mixtures of iron and all materials in moulds, *i.e.*, dry or green sands. These remarks would only apply to castings of more or less even sections. Given a very large block, no method of pouring or temperature can overcome the drawn place always found in the centre unless feeding is applied.

Sulphur Segregation and Slow Pouring.

With Mons. Ronceray's method of small runners the same result can be obtained by slow pouring. That is, given the same temperature of pouring, same material in the moulds, and equal time of filling the moulds, there would be the same effect whether using small or large runners, as the heat of the metal would be somewhere about the same in each case. Therefore the same change of volume. From the author's remarks, also the sulphur prints 15, 16, 17, it is plainly shown that it is no use casting cold, owing to the effect of S. segregation, and this is proved every day that the safest method to adopt is to cast as hot as possible to get clean castings that are free from "pin holes," especially for machined work and to make provision for feeding. It will be very complicated at present for foundries to have all kinds of casting temperatures for different castings.

What we as foundrymen have to accomplish is to overcome liquid shrinkage, as affected by the methods in use in everyday foundry practice, and the nearer we approach to the "steel-white cast iron series of irons" the greater provision we have to make for overcoming drawn and faulty castings.

Would the author give some further explanation of the statement "That the harder the iron the higher the temperature of solidification. Casting, therefore, must be performed at a correspondingly higher temperature"? This seems confusing, as the higher the combined carbon the lower the temperature of solidification, but the shorter the range between the liquidus and solidus, or a much shorter range of freezing, which implies that the reason for casting hard irons "hot is to overcome the effect of the mould on the shorter time of freezing."

The statement that top pouring with small runners is the only successful method seems to be a fact, as to attempt to run a casting in a low silicon mixture with bottom pouring with small runners is to ask for trouble, as very often short-run castings are the result.

Thanking the author for his excellent contribution, and trusting a lively discussion will result.—Yours, etc.,

FOUNDRYMAN.

Hytempite.

In a recent Paper on "Malleable Practice," it was stated that in working Reaumur process the boxes only lasted about three or four heats, but with the black hearts they lasted about seven. We have received from Messrs. F. J. Ballard & Company, Limited, of Tividale, Tipton, Staffs, a circular letter describing the properties of a nickel-chrome alloy, "hytempite," which should be a useful substitute for cast iron for annealing pots. Everybody has seen nickel chrome wire being used in connection with electric fires, and it will be readily realised that this type of material should prove very satisfactory for high temperature work. It is claimed by the manufacturers that "Hytempite" does not scale, crack or warp, and gives a service of 5,000 actual hours, as against cast iron working under similar conditions giving 200 hours. The alloy is stated to resist acids, alkalies, fumes and gases, and it will not oxidise under high temperature conditions.

Contracts Open.

Arlesey, Beds.—February 21.—Supply and delivery of a lift and force tar pump with two flywheels, for the Three Counties Mental Hospital. The Medical Superintendent, Arlesey, Beds.

Chesterfield.—Supply and delivery of cast-iron pipes, for the Rural District Council, viz.:—9-in. pipes, approximately 273 tons; 12-in. pipes, approximately 1,612 tons. Mr. G. Frith, Rural District Council Offices, Chesterfield.

Edinburgh, February 21.—Supply and delivery of iron standards, winding pillars, galvanised plain wire, wire netting, wrought-iron field gates, for the Town Council. Mr. A. Grierson, town clerk, City Chambers, Edinburgh.

Gloucester, February 19.—Supplying and laying a line of water main pipes, 9 in. in diameter, a distance of about 1,000 yards, for the Corporation. The Acting City Surveyor and Waterworks Engineer, Guildhall, Gloucester. (Fee, £2 2s., returnable.)

London, N., February 20.—Supply of one electrically-driven capstan, for the Tottenham District Council. The Engineer of the Council, Town Hall, Tottenham, N.15.

Catalogues Received.

HENRY RELS, 40, Great Marlborough Street, London, W.1.—From this firm we have received two catalogues; one is entitled "Single-Ended and Combined All-Steel Plate-Splitting Shears," and the other "All-Steel Punching, Shearing and Cropping Machines, Joist Shears for Hand Power." Foundrymen melting semi-steel may find some of these machines useful for reducing steel scrap to suitable sizes for charging into the cupola.

MESSRS. WILLIAM JACKS & COMPANY, Winchester House, Old Broad Street, London, E.C.2.—A card giving the approximate analysis of limpet softeners, which is: C, 3.45; Si, 4.55; S, 0.02; P, 1.5; and Mn, 0.35. It is claimed that 20 per cent. of limpet softeners will render fluid and open close-grained scrap, rendering the castings clean and easy to machine.

IT IS POSSIBLE that another furnace may be started at the Seaton Carew Ironworks early in February, but it may only be a replacement of a furnace which is already in operation.

SIR ROBERT A. HADFIELD (of Hadfields, Limited), in the course of an article in the "Yorkshire Evening News," says: The old bogey of foreign competition is being revived in the steel industry. This bogey will never be feared by any responsible steel expert. Actually the world is hungering for steel, and it is deplorable that this fact should be obscured by this old cry of "foreign competition," when in point of fact the scare is needless. Those who have their finger on the pulse of the industry will agree with me that foreign competition is not going to be so serious for our particular industry as some would have us believe.

An Apprenticeship Course in Foundry Practice.—XXX.

By Ben Shaw and James Edgar.

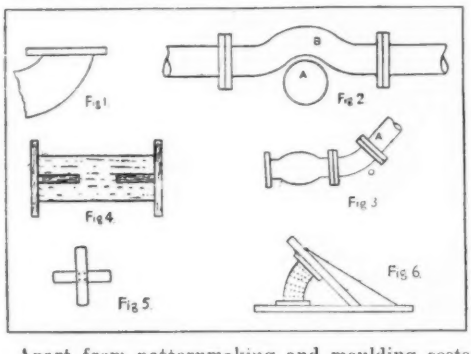
SKELETON PATTERNMAKING.

Part I.

Templates Made "To Place."

In a treatise on patternmaking a large part of the work would be taken up with the methods of skeleton patternmaking. The skeleton method of constructing patterns is neither growing more nor less popular. Its limits of usefulness are very clearly defined, while it may be admitted that, in some patternshops, skeletons are used when it would be much more profitable ultimately to make solid patterns, and, in other patternshops, there is an unreasoning prejudice against skeleton patterns and the foreman will not admit their usefulness for any purpose whatever.

Skeleton patterns are chiefly used for pipes and valves when only one casting is required, but the method is almost equally applicable for circular covers and other work of a like character. Sometimes, indeed, a number of castings can be made from a skeleton pattern almost as cheaply as if a solid pattern were used, and, when the choice is between a solid shell pattern and a skeleton, as for valve covers, etc., the skeleton pattern is preferred because of the ease with which the sand can be rammed between the section pieces, thus enabling a pattern to be moulded by bedding it in the floor, which would otherwise have to be moulded in a box and turned over.



Apart from patternmaking and moulding costs, the skeleton method is often adopted because of convenience. Patterns are not always made from drawings. A template may have to be fitted between two flanges and from this template a pattern has to be made, or, a variation of the practice is to make a pattern from a drawing supplied by the drawing office and afterwards try it "to place." Jointing up cast-iron pipe lines for steam or water often presents considerable difficulties because the closing up has to be perhaps of intricate shape or the lines are out of square, out of level, or out of line. The essential qualities of the patternmaker, who is sent out to take templates for a pattern, are confidence and decision. This applies particularly to repair work. There may not be even a sketch from which to work: consequently the patternmaker has to be his own designer. The conditions under which the templates have to be made, in many cases, tax the craftsman's initiative, because it may be necessary to erect a scaffold of some kind. With new work the difficulties are fewer, because it is usually possible for the drawing office to arrange for a closing-up piece to be in such a position as to make it convenient for constructing the template in position. A new pipe-line in an old ship may present almost insuperable difficulties, and it may be anything but a simple matter to clear various valves, columns, etc.

Novices' Difficulties.

When a closing-piece has to be made precautions have to be taken that there will be no hindrance to the flow of the steam or the water. The subsequent machining of flange-faces and boring of bolt holes—unless these are cored—must also be considered. All bends require to be of easy curves, and Y pieces should not be too abrupt in their junctions. With bends, the curves must not start at the junction of the metal with the flange, or it may be impossible to insert a bolt or turn a nut. Fig. 1 shows a pipe which a novice might make wrongly. The distance between the flanges is too short to make a neat pattern, and it might be necessary in such a case to have the adjoining pipe removed and make one pipe, instead of two. Fig. 2 is another case where a novice might go wrongly. The pipe A makes it necessary to arch the closing piece B, which is not satisfactory because of flow, but the writers have known cases where it was unavoidable. Fig. 3 is a good example of a closing bend. If this were a small bend two circular discs representing flanges and about 1-in. thick would be made and bolted to the flanges, after which a plate would be fitted between them with brackets connecting it to the discs. A straight template of similar construction is shown at Fig. 4. If the bend is of large diameter it might not be convenient to make circular discs for the flanges, therefore, after the size of the flanges of the pipes, between which the new piece has to fit, has been obtained and also the thickness of the metal of the valve or pipe A, as the metal of the closing piece would require to be of the same thickness, two half-lapped crosses like Fig. 5 would be made. Two blocks would now be planed up about $1\frac{1}{2}$ in. sq. and of the same length as the diameter of the flanges. Returning to the pipe line with some $\frac{3}{4}$-in. or 1-in. timber, the first operation would be to secure the crosses to the flanges, after which the blocks would be screwed on, care being taken to ensure their being level. As to whether they were central or not would not matter; indeed, they could not be if there were a drop in the pipe, unless they were planed to a bevel, which would be as inadvisable as unnecessary. Being a large pipe, a solid plate between the flanges would use much timber and it would be unnecessary. Two rails resting on the blocks, fastened to the flanges and screwed to them would be satisfactory for a medium-sized pattern, whilst if it were very large, it would be as well to make a half-lapped frame. Brackets would not be fitted on the top side from the cross to the middle plates. This would complete the template, but, before it is released from its position, a line would be drawn on the tops of the flanges, and in the case of shipwork where right- and left-hand patterns might have to be made, the template would be marked "port" or "starboard." Corresponding lead letters would be fastened on the patterns, and there could be no difficulty experienced in machining the casting and finally bolting it in position.

In making patterns of this kind care has to be taken to ensure that when the pattern is made it will clear any columns like that shown at Fig. 3 or other connections that may be in the way. When the patternmaker returns to the shop with a template, such as has been considered, he must nail strips on the faces of the flanges to allow for the contraction of the metal and the subsequent machining of the casting.

Using the Template.

The young patternmaker may succeed in making a strong and accurate template, but unless he has had considerable experience, may be at a loss as to how to use it for making the pattern. The simplest way of expressing the preparation that has to be made is to say that the fitting conditions have to be reproduced on the patternshop floor or on a building table. In the case of a bend, the construction of a template for which has been dealt with, one of the flanges would be set on a level board with another board laid against the other flange, supporting brackets being screwed behind it. A line would now be inscribed around

the crosses to get the centre of the flanges, and all marks transferred to the boards, after which the template would no longer be required by the patternmaker, although it is frequently used for determining angles at which flanges on the resulting casting are to be machined. Four half-flanges would next be made and one half screwed on each board, care being taken to have the straightedge in the same plane. A plate would now be fitted between the flanges, drawn to the necessary or advisable bend and then cut. The half-rounds or ground could now be fixed on, thus completing the shape of the body. Fig. 6 illustrates the arrangement. The other two half-flanges could then be nailed on temporarily until the plate, which has already been drawn off the other plate, has been dowelled on. The pattern would next be given the finishing touches.

Safeguarding the Patternshop.

The bend pipe described is, apart from short, straight pipes, as simple an instance of a pipe fitted-to-place as could be given. But such jobs are not always as simple. It is not uncommon for the patternmaker to find that he has to fit his template between two pipes swinging loose from slings, and the pattern will be expected to produce a casting which will fit between them. It is then necessary to safeguard his department, and this can best be done by having the template passed by the engineer-in-charge. In some shops it is the practice to utilise the template for the pattern; the flanges would be made the exact thickness required, and centre or frame so made as to be effective for the pattern. The objection to this is that when the template has been destroyed the patternmaker has lost his sole proof that the pattern was made to template, and that if the casting is not correct it is because the contiguous pipes have been shifted. It is not uncommon for a dispute between pattern shop, machine shop, and fitting shop to be settled by comparing the template with the pattern.

The experienced patternmaker always considers special allowances. In a long pipe the contraction allowance can only be gauged approximately: it may not contract as much as expected or it may contract more. Machining allowances differ in shops according to machining methods. With odd pipes having flanges at special angles they often do not come within the capacity of a lathe or flange-facing machine, but have to be dealt with on a shaper or a planer; this is a strong argument for making closing pieces as short as possible. It is a common practice, when making a pipe from a template, to make the flanges thicker than necessary, the extra thickness being left on the backs. The object of this is to ensure that if the pipe does not contract as much as is anticipated the flange faces can be machined until the pipe fits without making them too thin. In very small pipes this safeguarding allowance may be only 1/16 in., but in very large pipes ¼ in. may be advisable.

Templates for Valves.

When fitting templates for valves, and in this connection it may be said that it is sometimes necessary to fit the valve pattern to place, it is usually necessary to test carefully the cover-flange faces to ensure that they are level. In marine work especially there is a great deal of fitting-to-place and exceptional skill is required at times to fit bosses and branches so that they will serve their purpose properly and so that connections to them will not foul other pipes. It is not infrequently discovered, when a casting is bolted in position, that a branch pipe has been badly designed or positioned.

In describing the patternmaking for the bend pipe, it was explained that one flange should rest on the horizontal drawing board, but it is often more convenient for building the pattern to have both flanges approximately vertical, and, to do so, two "walls" are fixed on the floor or board. These "walls" are usually drawing boards. It may only be possible to construct one-half of the pattern between the boards because of the difficulty of getting at the underneath side, in which case battens screwed on the flange will keep the work rigid while building the grounds between them.

It is not always customary to make heavy templates such as have been described. There are cases, as for instance, straight pipes between vertical flanges parallel to each other, when only the distance is required and this can be obtained either by measuring with a standard rule or by making a template from ¼-in. timber. Sometimes, indeed when the flanges are not parallel thin templates of this kind are made, and the angles not determined by the template are measured. This is satisfactory to a point and may be necessary with repair work, but the patternmaker is not safeguarded as when a proper template is made, and there is not the same certainty that the resultant casting will be quite satisfactory.

An American Discussion on Iron Castings.

Mr. E. J. Lowery, addressing the members of the Pittsburgh Foundrymen's Association at its January meeting, said a thorough knowledge of the elements in the charge is essential to success in producing strong castings. He stressed the fact that there is a relation between the elements, one to the other, and discredited the idea that sulphur is a detriment to strength in castings, claiming that those of greatest strength ran as high as 0.10 per cent. in sulphur. He said the proper relation between sulphur and manganese is two of the manganese to one of sulphur plus 0.15, and not three to one, the more common estimate. Manganese has a direct relation to the carbon, and manganese up to 0.80 per cent. has little effect, either upon graphitic carbon or strength.

Touching upon phosphorus in the mix, he said that it is wrong merely to state that this element imparts fluidity; rather its function is to prevent shrinkage in the casting and to keep the metal liquid within confined areas. Carbon is an elusive element about which little is actually known, but its function is to impart strength. It has been developed that 1 per cent. of silicon will expel from 1¼ to 1½ per cent. of combined carbon. Iron itself is the element about which least is known, the speaker pointed out, adding that good iron is not necessarily the product of the blast furnace.

Mr. Lowery drew attention to wide variation in the silicon content of iron used for the same purpose. Radiator manufacturers use iron of 1.65 per cent. silicon in some parts of the country, iron of 1.90 silicon in others, and as high as 2.30 in still other places. Sheet bar roll-makers use iron ranging anywhere from 0.65 to 1.05 per cent. silicon, and automobile cylinder makers use iron running from 1.65 to 2.87 in silicon, other elements varying similarly.

The carbon factor is a neglected one, and its relation to other elements should be studied earnestly. The speaker also touched upon semi-steel castings and the strength imparted by steel in the charge. He illustrated by charts how castings of unusual tensile strength and high Brinell hardness marks had been secured by charging as much as 40 per cent. of steel; but such a ratio of steel to the charge could not be maintained daily, and had to be done at intervals.

Mr. David McLain, Milwaukee, was a visitor, and took a leading part in the discussion, incidentally recounting some of his experiences during a recent trip in Europe.—"Iron Age Report."

French Iron and Steel Output.

The French output of pig-iron in 1922 was 5,128,608 metric tons, of which 244,252 tons were forge iron, 1,259,043 tons foundry pig, 16,193 tons Bessemer iron, 3,441,857 basic, and 167,263 tons special pig-iron.

The French output of steel totalled 4,471,275 tons, of which 4,375,548 tons were ingots and 95,727 tons castings.

On January 1, 1923, the number of French furnaces in blast was 116: a further 54 were ready for blowing in, and 51 were in construction or under repairs.

Trade Talk.

A. J. CROFT AND COMPANY, LIMITED, have removed to 150, Alma Street, Aston, Birmingham.

MR. E. A. WATSON read a paper on "Permanent Magnets" to the members of the Sheffield Association of Metallurgists and Metallurgical Chemists last week.

BROOK, HIRST AND COMPANY, LIMITED, electrical switchgear manufacturers, Northgate Electrical Works, Chester, will in future trade under the name of Brookhirst Switchgear, Limited.

DORMAN, LONG & COMPANY, LIMITED, are shortly re-starting three blast furnaces at their Redcar Ironworks, two on the Coatham side and one on the Redcar side. The former have been standing idle for nearly two years.

PIGGOTT & COMPANY, LIMITED, of Birmingham, have secured the contract to supply half the steel water mains for a second pipe line from Taf Fawr to Cardiff, for the Cardiff Water Works Committee, at a cost of £118,222.

THE MEMBERS OF the Yorkshire branch of the Institution of Mechanical Engineers, met at the Leeds University on February 2 to hear a paper by Prof. W. T. David (Leeds) on "The Missing Pressure in Gas Engines."

CLEWORTH, WHEAL AND COMPANY, LIMITED, Grange Engineering Works, Trows Lane, Castleton, near Manchester, have appointed Dektereff, Francke and Reppman, of 118, Queen Victoria Street, London, E.C.4, as their agents for the London area.

AT THE Applied Science department of the University of Sheffield, on February 1, Professor C. H. Desch gave a lecture which was preliminary to a practical course of instruction on the use of pyrometry in modern furnaces. Mr. F. Clayton presided.

SWAN, HUNTER AND WIGHAM RICHARDSON, LIMITED, of Wallsend, have become associated with the New York Harbour Dry Dock Company, Incorporated, of Clifton, Staten Island, New York, which possesses floating docks of 12,000 and 8,000 tons capacity.

A CONFERENCE IN MANCHESTER on Tuesday representing 29 of the 35 unions in the engineering industry passed a resolution in favour of the amalgamation of these unions, and decided to appoint a committee to investigate the possibilities of such amalgamations.

THE DEPARTMENT OF OVERSEAS TRADE, 35, Old Queen Street, London, S.W.1, announce that H.M. Consul-General at Lyons reports that a local firm, stated to be buyers of large quantities of iron and steel, are desirous of receiving quotations from British firms.

THE UNDERFEED STOKER COMPANY, LIMITED, have recently taken orders for 67 travelling grates, 4 ash conveyors, and 10 stokers. One of the ash conveyors is for the Pentremawr Colliery Company, and 4 of the travelling grates for the Charbonnage du Hasard, in Belgium.

TWO FIRES at Wolverhampton, one on the premises of the British Tool & Engineering Company, Limited, Owen Road, and the other at the works of F. H. Lewis & Company, Union Foundry, occurred recently. In each case the fire was put out before damage of a very serious nature was done.

THE METHODS OF INSPECTION suitable for a medium-sized plant producing internal-combustion engine details or parts of a similar nature were described in a paper entitled "Practical Notes on Inspection," which was recently read before the Society of Engineers by Mr. A. Collis-Brown.

THE CLEVELAND DOCKYARD of Sir Raylton Dixon and Company, Limited, Middlesbrough, and the adjoining shipyard of William Harkness and Company have been acquired by a new company known as the Cleveland Shipbuilding Company, Limited, with a capital of £200,000 in £1 shares.

R. & W. HAWTHORN, LESLIE & COMPANY, LIMITED, Newcastle-upon-Tyne, have opened an office in Westminster at 3A, Dean's Yard, S.W.1. The office will be under the supervision of Mr. Robert S. Rowell, one of the company's directors resident in London. The City office at Exchange Chambers, 24, St. Mary Axe, will be continued as heretofore.

MR. G. F. DOWDING has resigned the London managership of the Talbot-Stead Tube Company, Limited, which position he has filled for the past four years. He is continuing his engineering business at the Morning Post Building, Strand, W.C., and also as London sales manager of the Projectile & Engineering Company, Limited, and the Sheffield Twist Drill & Steel Company, Limited.

THE ARDROSSAN DRY DOCK AND SHIPBUILDING COMPANY, LIMITED, have booked orders for one 8,400-ton single-deck vessel for the Bowring Steamship Company, Limited, London; one 8,400-ton single-deck vessel for the Gulf Line, Limited, London; one steamer for the Burns and Laird Lines, Limited, for their Glasgow-Belfast trade; and one for the City of Cork Steam Packet Company, Limited, for their Liverpool-Wexford trade.

LICENCES HAVE BEEN GRANTED under the Non-ferrous Metals Industry Act, 1918, to the under-mentioned:—Executors of W. Ralph, 26, Gray Mare Lane, Bradford, Manchester; Hughes, A., trading as Hughes & Hughes, 35, Crutched Friars, London, E.C.3; Hughes and Company, 27, Stepney Street, Llanelly; Metals and Accessories, Limited, St. David's House, Llanelly; Payne, J. A., trading as E. McCrone and Company, 82, Mitchell Street, Glasgow.

WORK was resumed at the United Steel Company's Moss Bay iron ore mines at Cleator Moor at the beginning of last week. It has just turned two years since operations ceased at these mines, which were then probably employing between three and four hundred men. It is understood that about 150 men are to start this week, the method of obtaining this number being by drawing lots, with the names of men at present employed in other mines omitted.

THE SHIPBUILDING, MARINE, MECHANICAL AND GENERAL ENGINEERING SECTION of the British Empire Exhibition is already on the fair-way to realise the ideals of its organisers, the British Engineers' Association. To-day, sixteen months ahead of the date of the opening of the Exhibition, the success of the section is already assured. It will contain a magnificent and comprehensive display of the finest workmanship, newest designs, and latest products of the engineering and metallurgical industries of Great Britain.

THE STANTON IRONWORKS COMPANY, LIMITED, near Nottingham, are putting three further blast furnaces into operation on March 1. This will mean that they will be working twelve out of their seventeen furnaces. The Stanton Ironworks Company have acquired Mr. Israel's patent for centrifugally lining metal pipes with concrete. There is nothing novel in the cement and concrete lining of metal pipes, but the method of doing this by Mr. Israel's process is novel, and results in a product claimed to be superior to the ordinary methods of doing this work.

A STRONG BELIEF in the capability of the staple trades of the Midlands rising superior to their difficulties if given a fair chance by lighter railway rates and taxation was the outstanding feature of the speeches delivered on Saturday at the annual dinner of the Staffordshire Iron and Steel Institute, at the Station Hotel, Dudley. There was an exceptionally large gathering, the president, Mr. Joseph Payton, being in the chair. The toast of the Iron, Steel and Coal Trades was proposed by Mr. C. Grant Robertson, Principal of the Birmingham University.

CHARLES WALMSLEY AND COMPANY (CANADA), LIMITED, who have taken over the Canadian business of Sir W. G. Armstrong, Whitworth and Company, Limited, and Charles Walmsley and Company, Limited, have acquired rights for the manufacture of water turbines, water and steam valves, Pelton wheels, hydraulic pumps, lock gates, and sluice valves, etc. The company have also obtained the rights to manufacture specialities of the Watford Engineering Works, Limited, which include their "Tremor" strainer. Similar arrangements have been completed with Gwynnes, Limited, covering their "Invincible" centrifugal pumps.

Gazette.

WEBB ENGINEERING COMPANY, LIMITED.—It has been resolved that the company should go into voluntary liquidation. Mr. A. Shankland, 82, Queen Street, Cardiff, I.A., has been appointed liquidator.

LEA SHIPBUILDING AND REPAIRING COMPANY, LIMITED.—It has been resolved and confirmed that the company should go into liquidation. Mr. W. F. Harris, 135, Fenchurch Street, E.C., C.A., has been appointed liquidator.

LUTTERWORTH AGRICULTURAL AND ENGINEERING COMPANY, LIMITED.—It has been resolved and confirmed that the company should go into voluntary liquidation. Mr. L. G. Teal, Bolebridge, Tamworth, has been appointed liquidator.

SOMERSET CONSTRUCTION COMPANY, LIMITED.—A petition has been presented by Mr. E. H. Bird, Sandringham, Burnham-on-Sea, engineer, for the winding up of the company. Messrs. E. F. & H. Landon, 53, New Broad Street, E.C., solicitors.

ENGINEERING PRODUCTS COMPANY, LIMITED.—A petition has been presented by A. W. Wall, Limited, Birmingham, general engineers, for the liquidation of the company. Hearing, Royal Courts of Justice, Strand, February 20. Agents, Needham & Barrow, 34, Essex Street, Strand, W.C., solicitors.

XUM

IRON AND STEEL MARKETS.

Pig-iron.

MIDDLESBROUGH.—Movements in the Cleveland iron market of late have developed a remarkably difficult situation, the rapid and unexpected advance in prices having had the effect of checking home consumers' demands, while the disturbed political conditions on the Continent have also been contributory factors to an unprecedented and complicated position in the industry. Consequently, buying is on a more restricted scale, and although many consumers are urgently in need of supplies, purchases are delayed in the hope that more settled conditions in the near future will enable them to deal on better terms than at present. In the meantime, stocks of pig in smelters' yards are practically exhausted, outputs at furnaces being entirely absorbed by current requirements, with the result that iron for prompt delivery is virtually unobtainable. Nor can consumers now rely upon supplies from foreign sources in the emergency, imports of iron in the Tees-side ports showing a heavy decrease, the total for the past three months amounting to 2,015 tons only, as compared with 28,011 tons a year ago, while the pre-war figure was 50 tons. In ordinary circumstances ironmasters would, of course, promptly put more furnaces into blast, but the increase in fuel costs deters makers from adopting this means of meeting the deficiency of supplies. Meanwhile, quotations continue to harden. Any small prompt lots of No. 3 coming on to the market are at once snapped up, and during the past few days have realised as much as 112s. 6d. per ton. Generally, however, there is no No. 3 available for this month at all, and the March-April quotation is very firm, with a further upward tendency, at 105s. No. 1 is quite unobtainable and nominal at 110s., but the little silicious iron to be had realises as much as 107s. 6d. No. 4 foundry is scarce, and stands at round about 102s. 6d. There are only small quantities of No. 4 forge about, and these are realising fully 95s. to 97s. 6d. per ton.

The strength of the hematite market is well maintained, both at Cleveland and on the North-West Coast, although the recent expansion of demand is hardly reflected in values, which are still actually and relatively well below those of foundry descriptions. While the home trade is thus very satisfactory, the export position is not so good, inquiry having been rather checked by the political and currency situation in Europe. Italy, however, is continuing to buy, owing, no doubt, to the failure of German deliveries. Prices move steadily upward. At last week's market East Coast mixed numbers could be done without difficulty at 103s., but at Tuesday's market a minimum figure was 105s., and some makers would not consider anything below 107s. 6d. Most makers, in fact, are completely booked up for February, and are quoting 105s. for March-April delivery. No. 1 is generally obtainable at a premium of 1s. per ton, while at Workington Bessemer mixed numbers were quoted at £5 15s. per ton delivered at Glasgow and Sheffield; £6 delivered at Birmingham and South Wales, and at £5 17s. 6d. per ton for export.

MANCHESTER.—The rapid advance of quotations for Cleveland iron has had an unsettling effect upon buyers in this district, and movements have consequently been restrained within somewhat narrow limits. There is still a fair amount of foundry iron to come into this district under old contracts at a cost of about 90s. per ton delivered; and as a large amount of foundry work has been based upon this price, to be asked now to pay 100s. and over is very disconcerting for the ironfounder. It is said indeed that competition for orders for castings keeps the price very low, and that no increase can be obtained to cover the rise in raw materials. Manchester consumers mostly confine purchases to Midland makes, and the prices for this quality pig are very irregular. Until recently it was possible, in some cases, to buy small lots of Derbyshire for prompt delivery at a cost of about 97s. or 97s. 6d. per ton delivered in Manchester; but many makers are now asking equivalent to 100s., and even 102s. 6d. delivered here. There is a little Lincolnshire foundry iron offering, but not yet very much, and the price here is about the same as for Derbyshire iron.

THE MIDLANDS.—Current demands for pig-iron in this area are well maintained, and in ordinary conditions would fully justify some increase of production but for the high prices and difficulty in obtaining adequate fuel supplies. Some smelters in the district are reported so well sold that they have no more iron to offer for early delivery. In such cases the prices quoted for March and April delivery seem rather high, and it is difficult to know what value to place on them, particularly as there does not seem yet to be any forward business booked at these figures. If conditions remain as they are, however, buyers and sellers must ultimately come together at about these levels. It is lamentable that larger and cheaper supplies of coke are not available, for no one interested desires to see the price of iron go soaring up. There is no greater profit in these high prices, and they invariably have a tendency to restrict demand. Quotations:—Northamptonshire forge, 77s. 6d.; No. 3 foundry, 85s.; Derbyshire forge, 82s. 6d.; No. 3 foundry, 90s.

SCOTLAND.—Pig-iron markets on Clydeside also reflect the growing strength of the trade, above described, and prices continue the upward tendency previously reported. Smelters are, however, reluctant sellers, but merchants, who appear to be holders of cheap iron, are filling a large proportion of the consumers' requirements at a shade under makers' prices. No. 3 Scotch foundry is 102s. 6d. to 105s. per ton at the furnaces for prompt delivery, but for forward business makers are inclined to hold out for 2s. 6d. per ton more. Users of Cleveland iron are finding difficulty in securing supplies of No. 3, and in any case it is at such an exorbitant figure as to force them to try substitutes. The shortage of No. 3 Cleveland is accentuated by the curtailment of deliveries from the Continent owing to the damping down of furnaces there for lack of fuel.

Finished Iron.

Business in the manufacturing branches of the iron trade presents a much more encouraging outlook than could have been anticipated a short time ago, and although by no means yet entirely free from difficulty, works are now fairly well employed, and are generally absorbing more labour in most districts. Relieved to some extent from the pressure of foreign competition, home demands for the commoner grades of bar-iron are on an expanding scale, makers in some districts, including Lancashire, benefiting by the occasion to advance quotations. From the Midlands very encouraging reports are received as to both marked and crown bars. Makers of the latter, who at this time last year were standing idle, are now fully occupied on day and night shifts, and are likely to remain so for some weeks unless the bottom falls out of the market. Scottish bar iron makers report plenty of business still passing for both home and export. The home price of bar iron has been increased by 10s. per ton, making the price now £11 per ton. This is the first change in price since August of last year, when the last reduction in bar iron was made. Export is still free, but makers are now asking round about £11 10s. or so per ton basis and up f.o.b.

Scrap.

Reports from the chief consuming centres of the scrap metal trade are confirmatory of a keen and increasing demand for most qualities of this raw material, with prices steadily advancing for all the leading qualities. At Sheffield, for example, the soaring values in the scrap market for all steel material are having the effect of inducing users to buy only such quantities as are imperative in the hope that quotations may ease as a result. The shortage, however, is so acute that merchants have no difficulty in securing their terms, and there seems no immediate prospect of better terms. Some dealers have disposed of all they have to offer. Some good heavy steel scrap is still to be had at from 85s. to 90s. Turnings for electric furnaces are rather dearer, and are becoming difficult to get hold of. Old rails for re-rolling cost anything up to 95s. Generally it can be said that steel scrap values have gone up 20s. since the middle of December. There is a fair lot of buying of iron scrap, but in Yorkshire the prices have not jumped up at the same rate as for steel material, though they are rising steadily. On Tees-side the demand for heavy steel scrap is particularly strong, and the price has stiffened to 85s. per ton. Heavy cast-iron machinery scrap is quoted at 90s., while ordinary descriptions realise round about 82s. 6d. per ton. There is a demand for heavy wrought-iron scrap, and for ordinary heavy piling 75s. to 77s. 6d. is obtainable. There is but little inquiry for specially-selected heavy forge, and the price stands at about 90s. Steel turnings and cast-iron borings are quoted at about 65s. to 67s. 6d. per ton. All quotations are delivered works.

Steel.

Steady and satisfactory progress may again be reported in the steel industry, most of the various departments having well-filled order books and a good volume of inquiries, which give encouraging evidence of a growing demand for material both at home and abroad. Movements in the market for steel

(*Continued on page* 148.)

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SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

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STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

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Telegrams: "LOWOOD, DEEPCAR."

IRON AND STEEL MARKETS,—*Continued.*

and semi-products indicate continued activity in buying, due in some measure to the difficulties of foreign producers, and the erratic course of European exchanges, which have had the effect of concentrating more orders in the hands of British makers. This is especially evident in the returns of shipments of rails from Middlesbrough, of which 31,166 tons were exported during the past twelve months to India, South Africa, Japan, Australia, and coastwise. Prices for semis continue firm, soft steel billets being in strong demand, with a minimum quotation by Welsh makers of £8 per ton delivered, while some Midland makers are asking £8 10s. The market for tinplates is very strong; the inquiry all round is considerable, and although the volume of business booked was perhaps not very large, this is accounted for by the fact that makers have had to decline orders which have come along on old quotations. Current prices for the basis sizes may now be called:—Coke finish, IC 14 by 20, 112 sheets, 108 lbs., 21s. 6d. to 21s. 9d. per box; IC 28 by 20, 112 sheets, 216 lbs., 43s. to 43s. 6d. per box, net cash, f.o.b. Bristol Channel. In ferro-alloys there is an active demand for spiegel, most makers being booked for a short while ahead, and the situation underlying the manganese market generally is very strong. No large quantities of 45 per cent. ferro-silicon have been called for recently, but several small lots ranging from 1 to 10 tons have been booked, while an order for 50 tons of 75 per cent. grade is noted. Over 700 tons of ferro-silicon of all grades were imported in this country in December, two-thirds of which came from Norway. The returns for last week show no silicon imports, but two parcels of silico-manganese to approximately 70 tons are shown. A fair inquiry for 40 to 50 tons of this alloy is noted, and Scandinavian competition is very keen.

Metals.

Copper.—Business in the standard copper market during the current week has remained steady, with values well maintained, the demand for home consumption showing increased expansion, and so far but little affected by political events on the Continent. American advices continue to denote firm conditions in that country, and doubtless the strength of the metal over there accounts in a large degree for the optimism with regard to the future that is exhibited on the home market. Manufacturers in the United Kingdom are encountering better trade conditions, while it is reported that some good orders for sheets and yellow metal have been booked from India. A fair amount of business is still being done with Germany, but France has been practically out of the market during the week. Stocks of copper on February 1 totalled 27,268 tons, an increase of 488 tons on the month. Current quotations:—*Cash*: Wednesday, £65 10s.; Thursday, £65 10s.; Friday, £65 12s. 6d.; Monday, £65 15s.; Tuesday, £65 17s. 6d. *Three Months*: Wednesday, £66 5s.; Thursday, £66 5s.; Friday, £66 7s. 6d.; Monday, £66 10s.; Tuesday, £66 15s.

Tin.—Movements in standard tin of late have disclosed a slight decline from the previous strength of the market, due in some measure to realisations on speculative account, and an unfavourable statistical position at the previous month's close. The prevailing impression in market circles appears to be that although values may recede to lower levels, it is not likely that they will remain so for any length of time, and sellers of metal for forward delivery are adopting a cautious attitude. The demand from America continues of an irregular character. The position over there is considered sound, however, and increased business with that country is anticipated before long. Meanwhile the demand from United Kingdom consumers is on a good scale. The deliveries for last month were as follow:—United Kingdom, 1,524 tons; Holland, 740 tons; America, 6,625 tons; Continent (except Holland), 788 tons; total, 9,677 tons. Current quotations:—*Cash*: Wednesday, £184 5s.; Thursday, £184 5s.; Friday, £184 15s.; Monday, £186 2s. 6d.; Tuesday, £186 15s. *Three Months*: Wednesday, £186; Thursday, £186; Friday, £186 10s.; Monday, £188; Tuesday, £188 7s. 6d.

Spelter.—The market for this metal has developed an irregular tendency of late, with prices, if anything, tending to lower levels. In the U.S.A. some irregularity has occurred with uncertain tendency, for, though consumption there remains good, production is developing, and may be estimated at about 45,000 tons for last month. Speculative influences have been fairly active during the week. Stocks of spelter on February 1 totalled 394 tons, a decrease of 237 tons compared with the month previous. Current quotations:—*Ordinary*: Wednesday, £34 17s. 6d.; Thursday, £34 17s. 6d.; Friday, £34 15s.; Monday, £35 2s. 6d.; Tuesday, £35 2s. 6d.

Lead.—Demand for soft foreign pig continues fairly active, but in some cases consumers are restricting purchases, owing to the high prices now ruling. In America the position is reported as very firm, with a good demand and supplies on a somewhat restricted scale. Stocks of lead on February 1 totalled 335 tons, a decrease of 183 tons compared with stocks in hand at the beginning of January. Current quotations:—*Soft foreign (prompt)*: Wednesday, £28 2s. 6d.; Thursday, £28 2s. 6d.; Friday, £28 5s.; Monday, £28 7s. 6d.; Tuesday, £28 7s. 6d.

Company News.

A. C. M. Furnaces, Limited, Moorgate, Rotherham.—Capital £5,000. Director: A. Crowcroft.

British Pig-irons, Limited, Abbey House, Victoria Street, Westminster, London.—Capital £5,000 in £1 shares.

Dearle, Limited, 36-38, Kingsway, London, W.C.2.—Capital £5,100 in 5,000 preference shares of £1 and 2,000 ordinary shares of 1s. each. Railway carriage builders.

Elcho Chemical Engineering Company, Limited, 8, Southwell Road, Sheffield.—Capital £1,500 in £1 shares. Permanent directors: J. H. Ellison (managing), T. Cox, and S. W. Shepherd. Secretary: Anna Ellison.

Engineering Specialists, Limited.—Capital £3,000 in £1 shares (1,800 ordinary and 1,200 preference). Directors: J. E. Grainger, G. W. Craig, W. G. Dixon and A. J. Tonge. Secretary: G. W. Craig.

Freemans, Limited, Sheffield.—Capital £600. Metal founders, etc.

Morris Engines (Coventry), Limited.—Capital £500,000 in £1 shares (150,000 6 per cent. cumulative preference and 350,000 ordinary), to take over the business of motor-engine and gear-box manufacturers, and engineers of the Société Anonyme des Anciens Etablissements Hotchkill et Cie at Coventry. Permanent governing director: W. R. Morris.

John Hetherington & Sons, Limited.—Interim dividend, 5 per cent. actual on ordinary.

Frederick Braby & Company, Limited.—Interim ordinary dividend. 5 per cent., less tax.

Normanby Iron Works Company, Limited.—Ordinary dividend, 12 per cent. per annum, less tax, for half-year.

Burnell & Company, Limited.—Debit balance to revenue account on December 31, 1921, £13,605; loss for year ended December, 1922, £4,842; written off in respect of depreciation of plant, machinery, and fixtures, £5,000; debit balance carried forward, £23,447.

Personal.

THE LATE MR. C. C. SWINBURNE, of M. W. Swinburne & Sons, Limited, brassfounders, coppersmiths and engineers, Wallsend, left £150,272.

THE LATE Mr. R. Hartley, senior partner in the firm of R. Hartley & Sons, iron and metal merchants, of Long Brookland, Bury St. Edmunds, left £4,670.

MR. H. THOMSON, a local director of Sir W. G. Armstrong, Whitworth & Company, Limited, has been appointed the director of Durham University Observatory.

ON THE RETIREMENT of Sir William Marwood, which took effect as from January 31, 1923, Mr. J. R. Brooke has been promoted to be Secretary to the Ministry of Transport.

MR. ERNEST NEWELL, of Misterton, has accepted the chairmanship of the Conisboro' Cliff Company, Limited, Doncaster, a concern recently formed to work the large deposits of dolomite in that district.

-eaths.

MR. G. H. HULETT, of Cleveland, U.S.A., the well-known designer of heavy equipment for handling coal and ore, died recently, aged 76 years. Probably his greatest achievement was the ore-unloading machine bearing his name. The first unloader of the Hulett type was erected for the Carnegie Steel Company, and many have since been installed at Lake Erie ports.

MR. ARTHUR MECHAN died recently at his home, Clifford Lodge, Largs. The deceased gentleman was the founder and for many years the head of the firm of Mechans, Limited, Scotstoun Ironworks, Glasgow. Mr. Mechan, who was in his 90th year, was a native of Glasgow, and established at Cranstonhill in 1862 the business with which he was so long associated. At the jubilee of the firm, which was celebrated in April, 1912, he presided over a large gathering of the employés at Yoker, among those present being about 100 persons who had been in the service of the company for 21 years or more.

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Send for Samples of the Oils with which you can mix a MAXIMUM quantity of sand using a minimum amount of oil—and get a Core Sand which will stand handling.

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WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	65 17 6
Three months	66 12 6
Electrolytic	72 15 0
Tough	70 0 0
Best selected	70 0 0
Sheets	98 0 0
India	84 10 0
Wire bars	72 15 0
Do. Feb.	72 15 0
Do. Mar.	72 15 0
Ingot bars	72 15 0
H.C. wire rods	77 0 0
Off. aver., cash, Jan.	64 11 1 7/11
Do. 3 mths., Jan.	65 3 9
Do. Settlement Jan.	64 11 0 8/11
Do. Electro, Jan.	71 10 10 10/11
Do. B.S., Jan.	69 2 2 3/4
Aver. spot price, copper, Jan.	64 9 10½
Do. Electro, Jan.	73 13 7½
Solid drawn tubes	13¾d.
Brazed tubes	13¾d.
Wire	10¾d.
Yellow metal rods	7d.
Do. 4x4 Squares	8½d.
Do. 4x3 Sheets	9½d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	10½d.
Rods, extruded or rolled	6¾d.
Sheets to 10 w.g.	10½d.
Wire	10½d.
Rolled metal	9¾d.

TIN.

Standard cash	186 15 0
Three months	188 7 6
English	186 15 0
Bars	188 15 0
Chinese	184 10 0
Straits	190 15 0
Australian	189 0 0
Eastern	194 0 0
Banca	188 10 0
Off. aver., cash, Jan.	181 18 6 21/32
Do. 3 mths., Jan.	183 9 5 19/32
Do. Sttlment, Jan.	181 18 4 10/11
Aver., spot, Jan.	181 17 0½

SPELTER.

Ordinary	35 2 6
Remelted	33 0 0
Hard	28 0 0
Electro 99.9	41 10 0
English	36 5 0
India	29 0 0
Prime Western	36 5 0
Zinc dust	49 10 0
Zinc ashes	13 0 0
Off. aver., Jan.	34 16 8 25/44
Aver., spot, Jan.	35 14 8

LEAD.

Soft foreign ppt	28 7 6
English	29 10 0
Off. average, Jan.	26 18 6 3/11
Average, spot, Jan.	27 2 4½

ZINC SHEETS, &c.

Zinc sheets, English	44 0 0
Do. V.M. ex whf.	42 0 0
Dutch	42 0 0
Rods	49 0 0
Boiler plates	41 0 0
Battery plates	42 0 0

ANTIMONY.

English regulus	27 10 0
Special brands	33 10 0
Chinese	24 10 0
Crude	18 10 0

QUICKSILVER.

Quicksilver	10 5 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
45/50%	12 0 0
75%	20 0 0
Ferro-vanadium—	
35/40%	17/- lb. va.
Ferro-molybdenum—	
70/75% c. free	9/- lb. mo.
Ferro-titanium—	
23/25%, carbonless	1/1½ lb
Ferro-phosphorus, 20/23%,	£23
Ferro-tungsten—	
80/85%, carbon free	1/5 lb.
Tungsten metal powder—	
98/99%	1/10½ lb.
Ferro-chrome—	
4/6% car.	£21 0
6/8% car.	£20 10
8/10% car.	£20 0
Ferro-chrome—	
Max. 2% car.	£55 0
Max. 1% car.	£65 0
Max. 0.70% car.	£75 0
67/70%, carbonless	1/6½ lb.
Nickel—99%, cubes or pellets	£130 0
Cobalt metal—98/99%	11/6 lb.
Aluminium—98/99%	£100
Metallic Chromium—	
96/98%	4/6 lb.
Ferro-manganese (net)—	
76/80%, loose	£15
76/80%, packed	£16
76/80%, export	£15
Metallic manganese—	
94/96%, carbonless	2/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	s. d. 2 6
Finished bars, 18% tungsten	3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive 4d. lb.

Rounds and squares under ½ in. to ¼ in. 3d. lb.

Flats under 1 in. by ⅜ in. to ⅛ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.

Bevels of approved sizes and sections 6d. lb.

If in coils 3d. lb.

Packing £3 ton.

Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces	3d.
Turnings and swarf	1d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£ s. d.	£ s. d.
Heavy steel	4 7 6	4 10 0
Bundled steel & shearings	4 0 0	4 7 6
Mixed iron & steel	3 18 6	4 5 0
Heavy cast iron	4 0 0	4 5 0
Good machinery for foundries	4 5 0	4 15 0
Cleveland—		
Heavy steel	4 5 0	
Steel turnings	3 6 9	
Cast-iron borings	3 6 9	
Heavy forge	4 10 0	
Bushelled scrap	3 16 9	
Cast-iron scrap	4 10 0	
Lancashire—		
Cast-iron scrap	4 3 9	
Heavy wrought	4 0 0	
Steel turnings	2 15 0	
London—		
Copper (clean)	58 0 0	
Brass (clean)	35 0 0	
Lead (less usual draft)	24 0 0	
Tea lead	20 0 0	
Zinc	24 10 0	
New aluminium cuttings	64 0 0	
Braziery copper	49 0 0	
Gun metal	44 0 0	
Hollow pewter	150 0 0	
Shaped black pewter	90 0 0	

Above are merchants' buying prices delivered yard.

PIG-IRON.

N. E. Coast—	
Foundry No. 1	110/-
Foundry No. 3	105/-
Forge No. 4	95/-
Mottled	90/-
Hematite No. 1	105/6
Hematite M/Nos.	105/-
Midlands—	
Staffs. common	—
,, part-mine forge	—
,, ,, foundry	—
,, Cold blast, ord.	200/-
,, ,, roll iron	210/-
,, basic	—
Northants forge	77/6
,, foundry No. 3	85/-
,, basic	—
Derbyshire forge	82/6
,, foundry No. 3	90/-
,, basic	—
Scotland—	
Foundry No. 1	110/6
,, No. 3	105/-
Hematite M/Nos.	110/-
Sheffield (d/d district)—	
Derby forge	86/-
,, foundry No. 3	93/6
Lincs. forge	86/6
,, foundry No. 3	92/6
,, basic	90/-
E.C. hematite	115/3
W.C. hematite	115/-
All d/d in the district.	
Lancashire (d/d eq. Man.)	—
Derby forge	—
,, foundry No. 3	98/6
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
,, foundry No. 3	98/6
Summerlee foundry	121/-
Glengarnock foundry	121/-
Gartsherrie foundry	121/-
Monkland foundry	121/-

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£ s. d.
Bars (cr.)	£11 0 to 11 10 0
Angles	£10 15 to 11 15 0
Tees to 3 united ins.	11 10 0
Nut and bolt	10 7 6
Hoops	15 0 0
Marked bars (Staffs.)	13 10 0
Gas strip	£10/15 to £11
Bolts and nuts, ¾ in. × 4 in.	16 10 0
Steel—	
Ship plates	£910/- to 10 10 0
Boiler plates	£12/10 to £13
Chequer plates	10 5 0
Angles	£9 5 0 to 9 15 0
Tees	£9 12 6 to 10 0 0
Channels	9 5 0
Joists	9 0 0
Rounds & squares 3 in. to 5½ in.	11 0 0
Rounds under 3 in. to ⅛ in.	10 15 0
Flats, over 5 in. wide and up	11 5 0
Flats, 5 in. to 1½ in.	10 10 0
Rails, heavy	9 0 0
Fishplates	13 0 0
Hoops	11 10 0
Black sheets, 24 g.	13 5 0
Galv. cor. sheets, 24 g.	£19 0 0 to 19 7 6
Galv. fencing wire. 8 g. plain	16 0 0
Rivets, ¾ in. dia.	13 0 0
Billets, soft	8 0 0 to 8 7 6
Billets, hard	8 10 0 to 8 15 0
Sheet bars	7 12 6 to 7 15 0
Tin bars	8 1 0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1 3¼
Sheet	1 4
Wire	1 4
Rods	1 2¾
Tubes	1 6¼
Castings	1 1¼

Delivery 3 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON, LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled—	
To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3¼ to 1/9½
To 15 in. wide	1/4 to 1/10
To 18 in. wide	1/4¾ to 1/10¾
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6¼ to 2/0¼
Ingots for spoons and forks	9d. to 1/3
Ingots rolled to spoon size	1/- to 1/6
Wire round—	
3/0 to 10 G...	1/6½ to 2/1½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	29.76
No. 2 foundry, Valley	27.00
No. 2 foundry, Birm...	24.00
Basic	27.96
Bessemer	29.27
Malleable	28.96
Grey forge	28.27
Ferro-manganese 80% delivered	107.50
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y, at mill	43.00
Bess. billets	38.50
O.-h. billets	38.50
O.-h. sheet bars	39.50
Wire rods	47.50
	Cents.
Iron bars, Phila.	2.47
Steel bars	2.10
Tank plates	2.10
Beams, etc.	2.10
Skelp, grooved steel	2.00
Skelp, sheared steel	2.00
Steel hoops	2.75
Sheets, black, No. 28	3.35
Sheets, galv., No. 28..	4.35
Sheets, blue an'l'd,9&10	2.60
Wire nails	2.70
Plain wire	2.45
Barbed wire, galv.	3.35
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	37/6 to 42/6
,, furnace	25/- to 27/6
Durham & North. fdy...	35/
,, furnace	29/6
Other Districts, foundry	32/6
,, furnace	26/6

TINPLATES.

f.o.b. Bristol Channel ports.

I.C.Cokes,	20×14, box	21/6
,,	28×20, ,,	43/-
,,	20×10, ,,	31/6
,,	18¾×14, ,,	22/6
C.W.	20×14, ,,	19/3
,,	28×20, ,,	40/6
,,	20×10, ,,	28/3
,,	18¾×14, ,,	19/9
Ternes. f.o.t.	28×20, ,,	40/-

TUBES.

	Up to and incl. 6 in.	
Gas ..	..57½%	Tube prices
Water	..52½%	are
Steam	..47½%	now free.

SWEDISH IRON.

Bars, hammered basis sizes—Basis price £22 to £23

	£ s. d.
Rolled Ordinary—Assortment ..	16 10 0
Nail Rods—Square, round and flats ..	to 17 5 0

Keg Steel nom. £38 to £40
Faggot Steel nom. £30 to £32
Blooms—
Single welded .. £10 to £11
Billets—
Single and double welded .. .. £13 to £14
Pig-iron—
Grey, white or mottled £6 10 to £7 5 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Feb. 7	65	10	0	inc.	5/-
,, 8	65	10	0	No change	
,, 9	65	12	6	inc.	2/6
,, 12	65	15	0	,,	2/6
,, 13	65	17	6	inc.	2/6

Electrolytic Copper.

Feb. 7	72	5	0	inc.	5/-
,, 8	72	5	0	No change	
,, 9	72	10	0	inc.	5/-
,, 12	72	10	0	No change	
,, 13	72	15	0	inc.	5/-

Standard Tin (cash).

Feb. 7	184	5	0	inc.	12/6
,, 8	184	5	0	No change.	
,, 9	184	15	0	inc.	10/-
,, 12	186	2	6	,,	27/6
,, 13	186	15	0	inc.	12/6

Tin (English ingots).

Feb. 7	184	5	0	inc.	15/-
,, 8	184	5	0	No change	
,, 9	185	0	0	inc.	15/-
,, 12	186	0	0	,,	20/-
,, 13	186	15	0	,,	15/-

Zinc Sheets (English).

Feb. 7	44	0	0	No change	
,, 8	44	0	0	,,	
,, 9	44	0	0	,,	
,, 12	44	0	0	,,	
,, 13	44	0	0	,,	

Spelter (ordinary).

Feb. 7	34	17	6	dec.	5/-
,, 8	34	17	6	No change	
,, 9	34	15	0	dec.	2/6
,, 12	35	2	6	inc.	7/6
,, 13	35	2	6	No change	

Lead (English).

Feb. 7	29	5	0	No change	
,, 8	29	5	0	,,	
,, 9	29	5	0	,,	
,, 12	29	10	0	inc.	5/-
,, 13	29	10	0	No change	

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1887	37 5	35 10	34 4	34 4	34 1	34 10	34 4	34½ 5	33 9	31 10	31 8	33 6	34 2
1888	32 2	31 1	31 5	31 9	30 11	31 5	32 4	33¼ 5	34 8	34 2	33 11	33 10	32 7
1889	33 8	35 0	37 5	38 9	38 6	37 10	40 1	43¼ 4	44 1	51 5	64 7	61 1	43 10
1890	60 3	53 1	51 0	47 4	42 2	41 5	43 2	45 7	47 9	47 10	47 4	43 1	47 6
1891	42 1	41 10	39 9	38 7	40 9	41 0	40 8	39 8	40 4	39 11	38 8	38 1	40 1
1892	37 7	35 7	36 10	37 10	39 2	40 11	39 11	39 10	40 0	38 6	37 6	37 4	38 5
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 0
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	55 7	54 8	50 8	50 0	56 2	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7¾	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7¼
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	91 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½

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ENGINEER, age 39, M.I.Brit.F., 23 years' experience home and abroad, Works, Office Correspondence, Brass and Iron Foundry Practice, General Engineering, Steel and Ironworks Plant, Locomotives and Rolling Stock, etc., desires responsible position Works or Office. —STEPHEN MOSS HOLDEN, c/o 99, Plantation Street, Accrington, Lancashire.

REPRESENTATIVES Wanted for all districts to Sell Special Pig-irons on commission basis. Must have live connections.—State full particulars, district covered, present agencies held (if any), age, and experience, by letter, to BOX 356, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

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NOTICE.

In the High Court of Justice, Chancery Division.

MR. JUSTICE SARGANT.

IN THE MATTER of Letters Patent granted to SVEN GUSTAF WINGQUIST bearing date the 6th day of June, 1907, and numbered 24,931, being Improvements in or relating to Ball Bearings,

and

IN THE MATTER of the Patents and Designs Acts, 1907-1919.

NOTICE IS HEREBY GIVEN that the Skefko Ball Bearing Company, Limited, whose registered office is situate at Luton, in the County of Bedford, and Aktiebolaget Svenska Kullagerfabriken, of Goteburg, Sweden, the Assignees of the above named Sven Gustaf Wingquist, have by Originating Summons dated the First Day of December, 1922, applied for an Order that the term of the said Letters Patent may be extended for a further term of five years, or for such other term as the Court shall think fit, AND NOTICE IS HEREBY GIVEN that on Tuesday, the 20th day of March, 1923, application will be made to the Court that a day may be fixed before which the said Summons shall not be in the paper for hearing, AND NOTICE IS HEREBY GIVEN that any person desirous of being heard in opposition to the said Summons must at least seven days before the said 20th day of March, 1923, lodge notice of such opposition at the Chambers of the Judge, Room 175, Royal Courts of Justice, Strand, London, and serve a copy thereof upon the Applicants.

Dated this 7th day of February, 1923.

BIRD & BIRD,

5, Gray's Inn Square, W.C.1, Solicitors for the Applicants, upon whom all documents requiring service may be served.

PATENTS.

INVENTORS Advice, Handbook and Consultations Free. KING'S PATENT AGENCY, LIMITED, Director, B. T. King, Regd. Patent Agent, 146a, Queen Victoria Street, London; 36 years' references.

PROPERTY.

FOR SALE.—A Freehold Farm in the Parish of Blisworth, Northants, containing 237a. 2r. 16p., with excellent House and Homestead and two Cottages. A valuable Bed of Ironstone underlies the farm.—For further particulars, apply to MERRY SONS & CO., St. Giles' Square, Northampton.

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Nine nearly new Steel Hopper Wagons, 4 ft. 8½in. gauge, 5 tons capacity.

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